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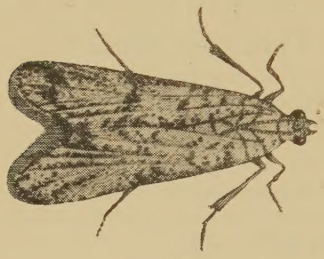

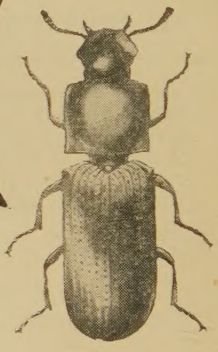

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TAKAHASHI (R.). **The Lac Insect.** [*In Japanese.*]—76 pp., 11 figs. Osaka, Japan Shellac Industries, Ltd., 1949.

An account is given of the morphology, bionomics and cultivation of *Laccifer lacca*, Kerr, including observations in Siam and Formosa. It has been successfully established in Formosa as a result of its importation on potted plants and as brood lac from northern Siam in 1940. Its parasite, *Tachardiaephagus tachardiae*, How., was brought with it, but it was eliminated at Taihoku in 1941 by covering the brood lac with metal gauze, with a mesh of 0·5 sq. mm., through which the crawlers escaped, but not the adult parasites. The only natural enemy of *L. lacca* in Formosa is *Eublemma roseonivea*, Wlk., which principally attacks the indigenous *L. greeni*, Chamb., in the south and is scarce in the north, and the lac harvest is very satisfactory.

DELATTRE (R.). **Insectes du cotonnier nouveaux ou peu connus en Côte d'Ivoire (II.).**—*Cot. et Fibr. trop.* **2** fasc. 3 pp. 97–100, 2 graphs, 10 refs. Paris, 1947.

In this second part of his paper on cotton pests recently observed in the Ivory Coast, the author deals in greater detail with *Bemisia tabaci*, Gennadius, and *Platyedra gossypiella*, Saund. [*cf. R.A.E.*, A **38** 140].

In September 1945, severe symptoms of leaf-curl appeared on cotton at the experimental station at Bouaké, and *B. tabaci*, the vector of the virus that causes it, was found to be present. High proportions of several varieties were infected, and 30–40 per cent. of the total were severely damaged. In 1946, the attack was much less general, about 30–60 per cent. of the plants being infected and 10–12 per cent. severely injured. The disease was less noticeable in native plantings. Suggested control measures include the destruction of *Sida carpinifolia*, *Ageratum conyzoides* and *Acanthospermum*, which are the most important wild food-plants of the Aleurodid, and the planting of its cultivated food-plants, which include cucurbits and *Dolichos*, only at a distance from the cotton.

P. gossypiella was found in the Ivory Coast for the first time in May 1944, and in 1945 it was reported that the whole area from Dimbokro to Korhogo and from Sequela to Mt. Bahiakro was heavily infested, and that cotton crops were markedly reduced. The moth may have been present for a long time, but the paucity of the local parasite fauna suggests that it is more likely to have been introduced with cotton seed imported a few years before from Nigeria. Observations on its development showed that larvae were very abundant in the first cotton flowers in early September, but when bolls were formed, they were most numerous in these. Development can be completed in flowers of cotton and *Hibiscus esculentus*, which were equally heavily infested, though *Hibiscus* capsules were rarely attacked. Infestation of cotton bolls showed peaks at the end of November, the beginning of January and the beginning of February, when 24, 30 and 60 per cent. were attacked, respectively. These peaks may correspond to the appearance of separate generations or may be due to climatic factors. Diapause occurred only in larvae in mature or open bolls. It began abruptly with the onset of the harmattan winds in January and was broken in April–June by the regular rains. Although some diapausing larvae in the seeds survive storage and cleaning, it is considered unlikely that they have an appreciable effect on infestation the following season.

Control depends mainly on crop hygiene. Cotton plants and all useless seed should be destroyed as soon as possible after harvest, and all sound seed sent to the ginning centre. The possibility of breeding resistant strains of cotton is considered. The parasites observed comprised *Bracon* (*Microbracon*) *kirkpatricki*, Wlkn., *Goniozus* sp. and *Brachymeria* sp. (probably *B. olethrius*,

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Wtstn.), but they were scarce, did not appear until January and did not attack the larvae in the flowers.

FRAPPA (G.). **Un nouveau parasite du cocotier à Madagascar** *Diocalandra taitensis* **Guér.**—*Agron. trop.* **2** no. 5–6 pp. 299–302, 1 fig., 9 refs. Nogent-sur-Marne, 1947.

Weevils collected on coconut at three places in the north of Madagascar in October–November 1943 were identified as *Diocalandra taitensis*, Guér. The distribution of this species, which is apparently of Malayan and Melanesian origin, is reviewed, the adults are described, and observations on its habits are recorded and compared with those in the literature [*cf. R.A.E.*, A **14** 524 ; **23** 548]. Adults were found on the palms in October and December and were most numerous at the foot of the stem, where adventitious roots are often produced. The eggs are laid on various parts of the plant, but chiefly in crevices at the base of the adventitious roots, between the inflorescences or at the base of the peduncle. The larvae appear to be able to pierce sound bark, and galleries were found at all heights. Roots near the points of attack died and were replaced by new ones, but destruction of a large proportion of the adventitious roots reduced tree vigour and nut production, and boring near the centre of the trunk killed the leaves. Water tended to accumulate in the galleries, and this caused decay of the surrounding tissues. Recommended control measures [*cf.* **14** 524 ; **23** 548] comprise cutting away and burning infested wood and tarring the wounds or fumigating them with wood smoke to prevent the development of fungi. Young palms should be earthed up to protect them from attack.

It has been suggested that infestation of coconut by *D. taitensis* favours attack by termites. In Madagascar, termites sometimes form colonies at the foot of coconut palms and construct galleries up the stems, but they do not appear to cause any severe damage ; *Rhina nigra*, Dru., and *Melittomma insulare*, Fairm., which attack the trunk [*cf.* **19** 448 ; **29** 341], are much more injurious.

CARIÉ (J. P.). **Sur une attaque de divers bois par** *Dendrolasius fuliginosus* **Latr.**—*Agron. trop.* **2** no. 5–6 pp. 303–309, 10 figs. Nogent-sur-Marne, 1947.

Lasius (*Dendrolasius*) *fuliginosus*, Latr., which is widely distributed in Europe and Asia, is common in France, where it occurs chiefly in dry situations. The nests are in tree stumps, particularly of poplar or willow, or in the soil. They are sometimes very large, and subsidiary nests are often made near the main one. The walls of the nests are covered with the mycelium of *Cladotrichum myrmecophilum*, which seems to serve as food, but insects and insect parts, seeds and, particularly, the honeydew of Aphids are also eaten. It is not known whether the ants feed on the wood they attack or merely use it as building material. Swarming occurs between May and September, and the nuptial flight is made usually in the afternoon but sometimes during the night. Females may return to the original nest or go to new ones after this flight. *L. fuliginosus* is a secondary social parasite, gradually replacing *L.* (*Acanthomyops*) *umbratus*, Nyl., or *L.* (*A.*) *u. mixtus*, Nyl., in nests in which the original inhabitants (*L.* (*A.*) *niger*, L., or *L.* (*A.*) *n. alienus*, Först.) have been replaced by the latter.

Injury to specimens of indigenous and exotic wood stored in a packing case in a garage near Paris is described. A nest containing large numbers of larvae and workers but no queen was found in the case after it had been exposed to attack for three months ; it appeared to be a branch colony of an older nest in the garden outside, with which it was connected by a gallery made by the ants. Comparison of the amount of damage caused to woods of different degrees of

hardness indicated that soft woods are the most severely attacked and that resistance is proportional to hardness, though other factors, such as odour or even toxicity, are also involved.

FRANZ (E.). **Ein Käfer als Schädling im Bergwerk.** [A Beetle as Pest in a Mine.] —*Natur u. Volk* **78** no. 10–12 pp. 179–180, 2 figs. Frankfurt a.M., 1948.

The Lucanid, *Dorcus parallelepipedus*, L., has recently caused severe damage to oak props in an iron mine in Hesse-Nassau ; it had apparently been introduced with the props about ten years before and had found favourable conditions for development in the warmer and damper parts of the mine. The larvae preferred decaying wood, and their activities favoured the spread of fungi, so that many of the props collapsed as a result of the combined attack. Damage was much less in the drier and cooler parts. As fumigation was impracticable, the use of a suitable wood preservative was suggested. Two Cerambycids, *Cerambyx scopoli*, Füssl., and *Plagionotus arcuatus*, L., were also found in the mine, but they were not numerous and are thought to be of no importance.

Holzschutzmittel. Prüfung und Forschung. III. [Wood Preservatives. Tests and Research. III.]—*Wiss. Abh. dtsch. MatPrüfAnst.* (2) pt. 7, [4+] 132 pp., 62 figs., refs. Berlin, Springer-Verlag, 1950. Price 21 *DM*.

This work comprises a series of nine papers, of which the two noticed below are directly concerned with the effect of treatment on insects.

BECKER (G.). **Ergebnisse einer vergleichenden Prüfung der insektentötenden Wirkung von Holzschutzmitteln. II. Teil** [Results of comparative Tests of the insecticidal Action of Wood Preservatives. Part II], pp. 40–62, 15 figs., 41 refs. The main purpose of the investigations described was to determine the effect of long exposures to wood treated with small amounts of preservatives on the older larvae of *Hylotrupes bajulus*, L. [*cf. R.A.E.*, A **27** 202], to compare their susceptibility with that of newly hatched larvae, and to work out a basis for the evaluation of various types of poisons and wood preservatives. The tests were made by impregnating small blocks of pine sapwood with materials of known degrees of effectiveness by immersion for 20 minutes at reduced pressure and then for 90 minutes, drying them for four weeks at 20°C. [68°F.] and 65 per cent. relative humidity, and introducing larvae weighing 30–300 mg. each individually into holes bored in them. The holes were plugged with cotton wool. Each block was then kept at 20°C. and 75 per cent. relative humidity and split open after a month to allow the condition of the larva to be examined ; if it was still alive, the halves of the block were tied together and further examinations made at monthly intervals for up to 8 or 12 months. Preliminary tests showed that larvae reared on pine sapwood and kept at 20°C. could survive starvation for long periods, the averages increasing from 9 to 23 weeks as the initial weight of the larvae increased from 100–110 to 190–210 mg., and this renders long tests necessary for purely stomach poisons.

The tests were made with five commercial oils or oil-like preparations and ten water-soluble materials, comprising arsenicals, fluosilicates, fluorides and two commercial preparations of unstated composition. The results are shown in detail in graphs and tables and discussed at some length. Of the first group, Xylamon-LX-Natur (a chlorinated hydrocarbon product [*cf.* **25** 658]) was the best, killing all the larvae in five months at 18 oz. per cu. ft. of wood and in 12 months at 5·1 oz. The results are compared in a table with those obtained in previous work with newly hatched larvae of *H. bajulus* and larvae of *Anobium punctatum*, Deg., and it was found that although the materials showed effectiveness in the same order against all three, and the newly hatched larvae of

H. bajulus were more susceptible than the older ones, with *Anobium* between the two, there was no constant relation for all materials between the degrees of susceptibility of larvae of the two ages, so that one could not be predicted from the other. It was apparent, however, that materials that gave 80 per cent. mortality of the young larvae in one month, or 100 per cent. in three, at 15 oz. per cu. ft., or the same mortalities of *Anobium* at 30 oz., would give complete mortality of the older larvae in 3, 6, 8–9 and 12 months at rates of 60, 40, 30 and 20 oz., respectively.

The water-soluble materials were sometimes more effective, but conclusions were difficult to draw because of their repellent effect, the consequent failure of the larvae to feed and considerable individual differences in resistance to starvation. The most rapid in action were arsenic trioxide, aluminium fluosilicate and sodium fluoride, which killed all the larvae in five months at 1·5, 3·3 and 7·1 oz. per cu. ft., respectively. All ten killed all the larvae in 12 months, the lowest rates of application that did so being 0·27 oz. for arsenic trioxide, 0·3 oz. for magnesium fluosilicate, 0·4 oz. for zinc fluosilicate, 0·5 oz. for potassium fluoride, 0·6 oz. for sodium fluoride, 1 oz. for aluminium fluosilicate, 1·1 oz. for potassium arsenate and 1·7 oz. for sodium arsenate. Higher rates gave inferior results in some cases. The data were again compared with similar ones for first-instar larvae and larvae of *A. punctatum*, and it was found that the lowest rates that gave complete mortality of the young larvae in three months closely corresponded with those that killed the older ones in a year. There was no relation with the figures for *Anobium*, which is known to be resistant to stomach poisons.

Numerous further experiments to assess the value of various metallic salts, oily materials and proprietary wood preservatives against the first-instar larvae of *H. bajulus* and larvae of *A. punctatum* are recorded and discussed at length. Fluorides and fluosilicates were the most effective of the salts, and an oil-like preparation with an unspecified contact insecticide added, the best of the others. Tables are given showing the minimum quantities of various materials, or groups of materials, that gave complete mortality of the larvae of *H. bajulus* of various ages in long periods and those that gave complete mortality of first-instar larvae of *H. bajulus* in four weeks and of larvae of *A. punctatum* in 12 weeks.

It is concluded from all these investigations and those of other workers that water-soluble materials are considerably less effective than oils against *H. bajulus*. In a final section, the relation between the chemical structure of various metallic salts commonly used as wood preservatives and their effectiveness against *H. bajulus* is discussed. The toxicity of the fluorides and fluosilicates, which proved not less than that of the arsenicals, is partly due to the liberation of gaseous hydrogen fluoride and hydrogen fluosilicate, respectively, and it varies directly with the amount of fluorine ion present. In metallic chlorides and sulphates, on the other hand, the metallic ion is the decisive toxic component and toxicity varies with the particular metal present. Thallium, arsenic and mercury are the most toxic, with little difference between them, followed at a considerably lower level of toxicity by zinc, chromium and copper, which again differ little among themselves.

Becker (G.). **Prüfung der " Tropeneignung " von Holzschutzmitteln gegen Termiten** [Tests of the Suitability under tropical Conditions of Wood Preservatives applied against Termites], pp. 62–76, 22 figs., 37 refs. An account is given of laboratory investigations on the effect of tropical conditions on the protection afforded by wood preservatives against termites. The test insects were nymphs of *Kalotermes* (*Calotermes*) *flavicollis*, F., and they were confined with small blocks of pine sapwood that had been impregnated under reduced pressure and either exposed to different simulated tropical conditions or kept at 20°C. and 65 per cent. relative humidity for 6, 7 or 16 months. The tests

themselves were made at 28°C. [82·4°F.] and 80 per cent. relative humidity and were continued until the insects died. The materials, the effectiveness of which was in general known, comprised three tar distillates, an oil emulsion (known to be unsatisfactory) and various water-soluble inorganic compounds. The results are shown in detail and discussed.

The effectiveness of the tar distillates was considerably reduced by the tropical conditions, especially dry heat ; whereas 15–20 oz. per cu. ft. of wood afforded complete protection after storage at 20°C. and 65 per cent. relative humidity, 30–40 oz. was required after 12 weeks' exposure to damp heat and 50–60 oz. after similar exposure to dry heat. Temperature was evidently the chief factor involved. A heavy tar distillate was the least affected. Dry heat did not reduce the effectiveness of sodium fluoride or sodium fluosilicate, but decreased that of potassium hydrogen fluoride and, particularly, aluminium fluosilicate. Damp heat was harmful to all the inorganic compounds to various degrees, owing to leaching from the surface layers.

Ext (W.). **Das Massenauftreten der Gammaeule,** *Plusia gamma* **L. in Schleswig-Holstein in Sommer 1946.** [The Outbreak of *Autographa gamma* in the Summer of 1946 in Schleswig-Holstein.]—*Z. PflKrankh.* **55** pt. 3–4 pp. 75–81, refs. Ludwigsburg, 1948.

An unusual outbreak of *Autographa* (*Plusia*) *gamma*, L., occurred in Schleswig-Holstein in July 1946 [*cf.* also *R.A.E.*, A **38** 146, etc.], and severe damage was caused to almost all field crops except cereals. Infestation was sporadic, and beans, peas and clover near woods and lakes suffered most. The first damage was reported on 12th July, from the Kiel district, and pupation began a week later. Adults were present at the end of the month and in the first fortnight of August, but their progeny caused no damage, probably owing to very heavy rain, though many larvae were killed by a bacterial disease and by parasites. The cause of the outbreak was unknown but is thought to have been connected with moisture conditions. Rainfall was abnormally heavy in 1945 and in June and August 1946, while July was unusually dry. Various insecticides were tried against the larvae, but their effects were difficult to assess owing to the onset of pupation. Dusts of DDT (Gesarol) and sprays of calcium arsenate appeared to give good control in many, though not all, cases, and dusting with calcium arsenate or a proprietary derris preparation (Kümex) was also fairly effective.

Kotte (W.). **Das Schadbild des Mohnkapselrüsslers** *Ceutorrhynchus macula alba* **Hrbst.** [The Damage caused by the Poppy Weevil, *Ceuthorrhynchus macula-alba*.]—*Z. PflKrankh.* **55** pt. 3–4 pp. 81–85, 5 figs., 13 refs. Ludwigsburg, 1948.

Ceuthorrhynchus macula-alba, Hbst., is an important pest of poppy in eastern and south-eastern Europe, but has not hitherto caused much damage in Germany. The author observed it in 1944, for the first time, on poppy in Baden. Up to 20 per cent. of the seed capsules were infested, which would correspond to a loss of about 15 per cent. of the seeds. Infested capsules contained 1–2 larvae each, were stunted and deformed, and became infected by fungi. In view of the increasing cultivation of poppy in Germany and the possibility that the weevil may become commoner, notes on its bionomics are given from the literature [*cf. R.A.E.*, A **24** 402]. Some of the infested capsules also contained larvae of the Cecidomyiid, *Dasyneura* (*Perrisia*) *papaveris*, Winn., which oviposits only in capsules already injured [*cf.* **33** 122], but as the larvae remain in them for some time after those of the weevil have left to pupate, they may erroneously be thought the primary cause of the damage.

Speyer (W.). **Versuche zur Beeinflussung der Diapause der Eier des Apfelblattsaugers** (*Psylla mali* **Schmidberger**). [Attempts to influence the Diapause of the Eggs of the Apple Leaf Sucker (*P. mali*).]—*Z. PflKrankh.* **55** pt. 3–4 pp. 85–89, 3 refs. Ludwigsburg, 1948.

The author, working in the district of the Lower Elbe, has shown a relation between the date of hatching of the overwintered eggs of *Psylla mali*, Schm., on apple and the sum of daily mean temperatures above freezing point subsequent to 1st March [*cf. R.A.E.*, A **25** 128], the average total for the years 1926–41 being 186°C. It has also been shown that the eggs remain in diapause until towards the end of February, and since their development cannot be influenced by temperatures during the diapause, the factors responsible for breaking it are of interest. In experiments designed to ascertain them, eggs on apple twigs were brought into the laboratory in early February 1938 and submitted to various treatments, and their development was compared with that of control eggs. The eggs were not affected by exposure for eight days to a relative humidity of 32·7 per cent. or immersion for 18 days in normal tap-water, but immersion for the same period in boiled water killed them. Hatching was somewhat accelerated after exposure to −15°C. [5°F.] for 15 minutes, but exposure for 1–3 hours caused injury and no eggs hatched after 24 hours' exposure. Heat accelerated hatching, immersion for 1 minute in water at 40°C. [104°F.] doing so the most, followed by dry exposure for 1½ minutes to 38·2°C. [100·76°F.] ; 50°C. [122°F.] was injurious. In tests of irradiation of various kinds, only X-rays accelerated development, and their effect was considerable. It remained undecided, however, whether in this and the other cases the diapause had actually been broken, and no conclusions are drawn as to the factors responsible for breaking it in nature.

Watzl (O.). **Der Lappenrüssler** (*Mylacus rotundatus* **Fbr.**) **als Getreideschädling.** [*M. rotundatus* as a Pest of Cereals.]—*Pflanzenschutzberichte* **2** pt. 7–8 pp. 97–100, 2 figs., 3 refs. Vienna, 1948. (With a Summary in English.)

Adults of *Mylacus rotundatus*, F., attacked autumn-sown rye and wheat in a locality north-east of Vienna in April 1948. They fed during the day on the leaves and leaf-sheaths, the holes left being similar to though larger than those caused by flea-beetles, and sheltered on the ground at night or in cold weather. The infestation was probably favoured by the delayed development of the cereals caused by drought in the preceding autumn and by the unusually warm winter, which induced early activity of the weevils in spring.

Franz (J.). **Ökologische Beobachtungen am Buchdrucker** (*Ips typographus* **L.**). **Teil I.** [Ecological Observations on *I. typographus*. Part I.]—*Zool. Jb.* (*Syst.*) **77** pt. 6 pp. 426–442, 10 figs., 21 refs. Jena, 1948.

A detailed account is given of observations in spruce forests near Munich in 1946 and 1947, some of which have already been noticed [*R.A.E.*, A **38** 163], showing that large numbers of adults of *Ips typographus*, L., sometimes overwinter in the ground. This occurred chiefly when infested trees had been felled in the autumn or winter and is attributed to incomplete destruction of the beetles in the bark. It was found by the use of special emergence cages, which were placed over the ground, that the numbers hibernating in this way exceeded six million per acre in one felled area in 1946 and two million in 1947, and these figures were confirmed by counts of beetles in numerous samples of soil taken outside the cages. Hibernation occurred in the surface litter and humus and even in the mineral soil, which was a mixture of clay and sand. Most of

the beetles in the mineral soil occurred in the upper 2 ins., but some were found down to 10 ins. Places that were not covered with needles or were permanently wet were avoided. Mortality was slight, and much less than that of beetles hibernating in the trees.

The beetles emerged from the soil at about the same time as those hibernating in the trees, between the first week in April and the beginning of May. Emergence began mostly at about noon, reached a peak at about 3 p.m. and ended at 5–7 p.m. It did not occur until the temperature of the upper layer of the soil reached 9–10°C. [48·2–50°F.], and increased in intensity as the soil became warmer. The connection with air temperature was less pronounced, but on the whole, mass emergence began when this reached 15°C. [59°F.] 20 ins. above the ground in shady sites and 19–20°C. [66·2–68°F.] 40 ins. above ground in clearings. Its intensity was correlated with maximum air and soil temperatures and especially with their persistence above the minima for emergence. The cessation of the emergence in the evening seemed to depend more on decreasing light than on temperature.

Regeneration and maturation feeding occurred from the end of March till the middle of May [*cf.* **38** 164], beginning 1–2 weeks before the mass emergence from the soil. The beetles were observed feeding under bark lying on the ground and under loose bark on stumps of trees felled in the previous year, and the peak was reached at the beginning of May, when they attacked all standing and lying trunks irrespective of age, especially pole wood near recently felled areas. The numbers of beetles observed exceeded 16,000 per sq. yard of bark in some situations.

FRANZ (J.) **Über die Erfolgskontrolle beim Arbeiten mit begifteten Fangbäumen gegen Borkenkäfer.** [The Assessment of the Results in working with poisoned Trap-logs against Bark-beetles.]—*Allg. ForstZ.* 1948 no. 12 pp. 113–114. Munich, 1948.

The increasing use of insecticides on trap-logs to kill the bark-beetles that are attracted to them [*cf. R.A.E.*, A **38** 144–145, etc.] has led to the adoption of various methods of assessing the results. It is necessary to investigate not only the mortality of the beetles that succeed in entering the log, which is done by removing the bark from the treated section at the end of the flight period, but also that of the beetles that do not. This is best done by spreading a sheet beneath the log, collecting the beetles found on it at least once a day (to avoid their removal by birds) and observing them in the laboratory. The total percentage mortality is obtained by combining the two sets of figures, and their relation to one another is an indication of the rapidity of action of the poison, since a slow-acting stomach poison permits more beetles to enter the log than a quick-acting contact poison. Natural mortality is calculated from an untreated log, and results from logs exposed to different conditions are combined.

The method has some disadvantages. Some beetles may leave the log without entering it and perhaps die elsewhere, though the number to do so is in inverse relation to the effectiveness of the insecticide, and samples of the beetles found on the surface of the log should therefore be kept and observed for mortality. Some may leave after entering, owing to increasing temperature, and untreated logs should be observed for this and the experiment concluded if it occurs. The duration of effectiveness of the insecticide should be ascertained previously in the laboratory. The great advantage of the method is that it yields absolute figures of living and dead beetles per log, which can further be used as an indication of any repellent effect of the insecticide. It is not easy to determine the latter since no comparison can be made with the numbers

attracted to untreated logs, as contrasted with those that enter them, but visual inspection of the behaviour of beetles on the log will assist.

It has been sought to evaluate the effects of treatment by comparing the numbers of entrance holes and living progeny in treated and untreated logs. This is less satisfactory, since the number of holes gives no information as to the number of beetles killed on the surface, and a reduction of progeny is of little value unless it amounts to complete sterility.

Saalas (U.). **Suomen metsähyönteiset.** [The Forest Insects of Finland.]—719 pp., 654 figs., 9 pp. refs. Helsinki, W. Söderström OY., 1949.

This comprehensive work on the forest insects of Finland opens with general accounts of the morphology and anatomy of insects, their modes of reproduction and development, their different feeding habits, the economic importance of insects in forests and their control, whether by natural enemies and diseases or by insecticides. The main part that follows is divided into sections dealing with the orders of insects concerned, in which information is given on large numbers of individual species, with keys in some cases and numerous illustrations. Beneficial insects are included as well as pests, and bionomics, ecology and control receive special attention. The causes that lead to outbreaks are discussed. The importance of other animal groups in forests, largely birds and mammals but also including spiders and mites, is discussed in a final section, and there is an appendix in which insects and other pests are listed under the trees that they attack.

Staniland (L. N.) & Mayor (J.). **A home-made Dusting Machine—simple, cheap and effective.**—*Agriculture* **54** no. 11 pp. 518–524, 16 figs. London, 1948.

Details are given of the construction and operation of two models of a home-made dusting machine designed principally for applying dusts against flea-beetles on low-growing crops but also suitable for other purposes.

The smaller one, which is pulled by hand, consists of two square wooden wheels, 3 ft. apart, with a four-sided cage of wire netting extending between them. One or more hessian bags are tied to swivels inside and lie loosely on the netting. One full-sized bag (3 ft. long and 10 ins. in circumference) can be used to dust a 3-ft. swathe or small ones strung at suitable intervals to dust 2–4 single drills. They should be filled with dust to three-quarters of their capacity. The wheels have lugs in the corners to catch in the soil and make them turn when the duster is pulled along ; the bag falls to the netting floor of the cage, and dust is shaken out. The machine should be lifted while turning at the headlands. A 3-ft. bag applies about 7 cwt., 2 cwt. and 50 lb. per acre when made of coarse, medium and fine hessian (10, 12 and 16 holes per inch), respectively.

The larger model works on the same principle, but is $6\frac{1}{2}$ ft. wide, drawn by tractor or horse and provided with a device that puts the turning lugs out of action when required, as it is too heavy to lift by hand. A fine hessian bag of the full size (6 ft. long and 19 ins. in circumference) applies 2 cwt. dust per acre.

Jary (S. G.), Rolfe (S. W. H.) & Carpenter (K.). **The Leek Moth.**—*Agriculture* **54** no. 12 pp. 563–569, 1 map. London, 1948.

The authors summarise information on the life-history of the leek moth [*Acrolepia assectella*, Zell.] in England, obtained since its occurrence was reported in 1945 [*cf. R.A.E.*, A **34** 69], and describe experiments on its control with insecticides. The moth is known to occur in coastal areas of Suffolk, Kent,

Sussex, Hampshire and the Isle of Wight. It is practically certain that there are three generations a year, with possibly a partial fourth in exceptionally favourable seasons, and that the winter is passed in sheltered positions in the adult stage. The overwintered adults oviposit from mid-April to early May on overwintered plants of leek, perennial onion or garlic or sometimes on shallots, and attack by the larvae is seldom evident before the second week of May. First-generation adults begin to appear during late June and oviposit throughout most of July, and the second-generation larvae attack seedling leeks from the middle of July, sometimes destroying them. They pupate in early August on the outer leaves of the plants, especially on dead tissue, and adults emerge from the middle of August and oviposit on leek and other plants, including those producing seed heads. The third-generation larvae are the most numerous and injurious and destroy many plants ; they pupate on the outer leaves or among the stalks of the seed head, and give rise to adults that emerge during late October and early November and overwinter.

Preliminary tests in 1945, in which all insecticides were used as both sprays and dusts, indicated that benzene hexachloride was almost ineffective and liable to cause severe plant injury and that nicotine, though of some value, was less effective than DDT. These results were confirmed in more detailed tests on leek in 1946, and it is concluded that good control should be obtained by the application of an emulsion spray containing 0·1 per cent. commercial DDT or a dust containing 5 per cent. commercial DDT at any time from early July onwards, when the first sign of damage is seen, and then at intervals of 2–3 weeks.

SMALL (T.). **Colorado Beetle in Jersey, 1947.**—*Agriculture* **54** no. 12 pp. 569–574. London, 1948.

In 1947, only four adults of the Colorado beetle [*Leptinotarsa decemlineata*, Say] were found on the sites of former outbreaks in Jersey, showing that the measures taken to combat the widespread and heavy infestations of 1945 had been effective [*cf. R.A.E.*, A **36** 259–260], but a large invasion of beetles, presumably from France, occurred at the end of May [*cf.* **38** 231]. They oviposited on potato within a few days, and newly-hatched larvae and pupae were found in June and July, respectively. Adults of the new generation were noted in the field on 25th July, and beetles that emerged in the laboratory on 30th July began to oviposit two weeks later. The last larvae and adult of the season were found on 25th August and 16th September, respectively. In nine rather serious outbreaks, 15–49 beetles were found on potatoes, but in seven of these no insects were found after 5th July. Young adults were observed in 11 places. Larvae were found scattered throughout the crop in six places and on small areas in 46 others. No insects were found after the end of July in 49 of these places and it was thought that there would probably be no recurrence of the pest in 1948 in many of them [*cf.* **38** 232]. Almost all early discoveries of insects were made in coastal areas in the south-east and east of the Island, and most of the infestations throughout the season occurred in the east.

Volunteer potato plants are important as food-plants of *L. decemlineata* in Jersey, and measures are taken to prevent their occurrence. Potatoes must be planted only in areas in which they were grown the previous year [*cf.* **36** 259], and grass or cereals, which are liable to hide volunteer potato plants, must not be sown without permission on land that has carried potatoes in the past year. In 1947, the insects were found on volunteer plants in 23 places among various crops and on a rubbish heap, and these plants were retained as traps where possible. A few adults but no eggs, larvae or injury were found on tomato. Adults were found on *Solanum nigrum*, but had not fed on it, and a few instances of feeding by larvae were observed on this weed.

Routine sprays containing lead arsenate were applied to all potato crops from early May until early October. When single beetles were reported, the neighbourhood was inspected, but no other special precautions were taken. When many adults or larvae were found scattered in a crop, inspection and collection by hand were carried out at short intervals and the crop was re-sprayed as soon as it was safe. At harvest, isolated rows were left as traps until the late crop had developed sufficiently to attract any remaining beetles. When the outbreak was localised in a crop, the traps were confined to the infested area and a preliminary soil injection with carbon bisulphide made. At one period the adults were observed to be feeding only slightly or not at all, and the infested crops were therefore dusted with 5 per cent. DDT. Measures were taken to prevent the export of tubers from infested fields.

CADMAN (C. H.) & HILL (A. R.). **Aphid Vectors of European Raspberry Viruses.** —*Nature* **160** no. 4076 pp. 837–838, 3 refs. London, 1947.

Cultivated raspberries in Scotland and, to a less extent, England have decreased in vigour and productivity during the past decade, chiefly owing to the spread and cumulative effect of a number of virus diseases. The way by which these diseases were spread in the field was not known, but insect transmission was suspected [*cf. R.A.E.*, A **29** 287] and was confirmed in experiments in 1944–46, which are briefly reported. *Amphorophora rubi*, Kalt., and *Aphis idaei*, v.d. Goot, are the only Aphids of general occurrence on raspberries in Scotland, and tests in 1944–45 showed that both could act as vectors of viruses causing two distinct types of mosaic disease [*cf.* also **35** 312] ; attempts to effect transmission by Jassids and thrips were unsuccessful. In more detailed experiments in 1946, Aphids of each species that had fed for 3, 7, 14 or 21 days on plants from a stock of Lloyd George raspberries that appeared healthy, but was known to be infected with at least the mosaic 2 virus or viruses [see next abstract], or for 12 hours on detached leaves of the same stock were transferred to lots of ten virus-free plants of the indicator variety, Norfolk Giant, on which they were allowed to feed for periods of up to 14 days. Symptoms of virus disease appeared on five of the 40 plants exposed to *Amphorophora rubi* and six of the 40 exposed to *Aphis idaei* after infection feeding periods of three days or more ; 12 hours was apparently not long enough for the Aphids to pick up the infection. Four of the plants infected by *Amphorophora rubi* developed symptoms of mosaic 2 only, but the other plant infected by this Aphid and the six infected by *Aphis idaei* all developed symptoms of a distinct and hitherto undescribed disease provisionally designated " curly dwarf " [see next abstract]. Except in a subsidiary experiment using seedling plants of a Norfolk Giant hybrid, in which infection with mosaic 2 by *Amphorophora rubi* was effected by as few as 25–50 Aphids per plant, very large numbers of Aphids were required for transmission ; this is in agreement with the slow spread of mosaic diseases in the field.

HARRIS (R. V.). **A Review of some recent Research on Virus Diseases of Raspberry and Strawberry in Great Britain.**—*34th Rep. E. Malling Res. Sta. 1946* pp. 113–117, 14 refs. East Malling, 1947.

Work on the nature and transmission of virus diseases of strawberry and raspberry that have caused serious degeneration of stocks in Great Britain during the past 25 years is reviewed ; that on strawberry viruses has been noticed from other sources [*R.A.E.*, A **31** 142 ; **36** 376, etc.]. The diseases that affect raspberry are mosaic and, in Scotland, leaf-curl also. Raspberry mosaic disease produces symptoms of two distinct categories on the highly susceptible variety Baumforth's Seedling B, which was the only indicator

variety used up to 1942. They could be distinguished visually when they occurred in combination, and were provisionally designated mosaic 1 and mosaic 2. When mosaic 2 was transmitted by grafting to the variety Lloyd George, no distinguishable symptoms developed on the leaves, but plants from which all canes showing mosaic symptoms had been removed were able to transmit mosaic 2 by grafting to Baumforth's Seedling B. Mosaic 1 produced typical symptoms on Lloyd George and, when it was combined with mosaic 2, intensified mosaic symptoms developed that differed from both parent types and were designated common " Lloyd George mosaic ". Infection by mosaic 2 results in some loss of vigour in Lloyd George, as do also, to a still greater extent, other unidentified viruses that increase degeneration, but do not produce distinct symptoms.

Most of the stocks of Lloyd George raspberries in Great Britain were found to be degenerate ; one that had been propagated since 1931 some miles from commercial stocks and from which all plants with visible virus infection were rigorously removed had maintained exceptional vigour, but was found when tested on Baumforth's Seedling B to be widely infected with mosaic 2. Some of the indicators in this experiment developed inconspicuous curling symptoms without mosaic mottling and when the virus was transferred from them to symptomless plants of the variety Norfolk Giant, distinct vein-clearing of the mosaic 1 type was produced. This disease is distinct from Scottish leaf-curl and is referred to as curly dwarf [*cf.* preceding abstract]. In Norfolk Giant and Baumforth's Seedling B, it produced a very intense mosaic 2 symptom followed by death. It is concluded that mosaic 1 and mosaic 2 comprise complex associations of viruses and that the experiments of Cadman & Hill indicate that two of the viruses of the second complex are transmitted selectively by *Amphorophora rubi*, Kalt., and *Aphis idaei*, v.d. Goot, respectively [see preceding abstract]. Cadman has listed eight types of symptoms on Norfolk Giant, including the Scottish leaf-curl, which produces a characteristic blotch symptom, is carried without symptoms by the variety Lloyd George and is not known to occur in England.

Massee (A. M.). **A new Method of rearing the Fruit Tree Red Spider (*Oligonychus ulmi* Koch) on Apple Seedlings.**—*34th Rep. E. Malling Res. Sta. 1946* pp. 122–123, 1 pl., 1 ref. East Malling, 1947.

Winter eggs of *Paratetranychus pilosus*, C. & F. (*Oligonychus ulmi*, auct.) for laboratory tests of acaricides have hitherto been obtained by collecting shoots bearing them [*cf. R.A.E.*, A **26** 297]. These are kept in water or damp sand before and after treatment and observed for hatching in late February or March. Life-history studies have been conducted similarly. The disadvantages of this method are that the percentages of eggs that hatch on cut shoots are sometimes very low, and it is difficult to distinguish those that hatch after treatment from any that have hatched before or that may have been sucked dry by predators in the previous autumn. An improved method was therefore developed using potted apple seedlings, raised by a technique that is described. The Worcester Pearmain variety was selected, as it is relatively resistant to mildew and has physical characters favourable to the mite ; if mildew develops during the summer it is controlled with a copper fungicidal spray, which is not toxic to the eggs or adult mites. For summer tests, five newly emerged adult females and one adult male are placed on each seedling, which they are prevented from leaving by a ring of petroleum jelly round the base of the stem. The five females deposit a total of about 150 eggs, which was found to be a suitable number for examination on a seedling apple. To obtain winter eggs, the adults are placed on the seedlings about the middle of July ; oviposition is complete by October, and any mites that fall off or die before then should be

replaced. The seedlings bearing the winter eggs are kept plunged in the open ground before and after treatment, and when hatching is complete they are removed to the laboratory, where they are cut off at ground level and examined. Studies on the life-cycle can also be carried out on seedlings in the laboratory.

MASSEE (A. M.). **Notes on some interesting Insects observed in 1946.**—*34th Rep. E. Malling Res. Sta. 1946* pp. 124–128. East Malling, 1947.

Insects observed on hops in south-eastern England in 1946 included the weevils, *Epipolaeus caliginosus*, F. [*cf. R.A.E.*, A **26** 613] and *Otiorrhynchus singularis*, L. *E. caliginosus* appears to be widely distributed, though not very abundant, in Kent, and the larvae severely damaged the roots and stems of one-year-old sets in a district in which it appeared to be well established. The damage was first observed in March, and at the end of April some of the hills were removed in consequence. The injured roots quickly decay, and the larvae then leave them and attack others. Adults of *O. singularis* attacked the young shoots in a recently planted hop garden in one district and young hop sets at East Malling during May [*cf.* **32** 83]. They girdle the stems, destroy the tips of the shoots and defoliate the bines, and are difficult to control because they are nocturnal and travel considerable distances and because the bines grow so quickly in spring that insecticides applied during the day cannot protect the growth made during warm evenings. Experience has shown that infestation is checked by arsenical sprays applied during cold spells, when growth is slow, combined with constant cultivation of the soil. The bines are rarely attacked when they are more than 3 ft. long. *O. singularis* seriously damaged raspberry over an area of three acres in the middle of a large plantation in Scotland during May–June in 1945 and 1946. The weevils skeletonised the leaves and ate through the stems of the fruit trusses, and the crop and the size and vigour of the current growth were reduced. Similar damage, on a smaller scale, has been observed in south-eastern England.

Sitona lineatus, L., a pest of leguminous crops, occurs in small numbers on fruit trees, especially apple, where it is not normally of importance. At the end of July, when the haulms of peas growing under recently planted apple trees at East Malling were removed, however, the weevils migrated from them to the trees and fed on the tender leaves for about three weeks before dispersing.

In March, apple trees over an area of 8½ acres were sprayed with an emulsion containing 2 lb. DDT per 100 gals. at a rate of 1,000 gals. per acre for the control of the apple blossom weevil [*Anthonomus pomorum*, L.]. The treatment was successful, but on 3rd April, many thousands of dead beetles, among which beneficial species (*Harpalus aeneus*, F., and *Amara* spp.) were the most abundant, were found in hollows or depressions in the ground. Other insect predators and spiders, which are normally abundant at that season, were not found, but insect populations began to increase in the latter part of April, and by blossom time several beneficial species were as prevalent as in a neighbouring unsprayed orchard.

The roots of strawberry in several fields in Kent were attacked by larvae of *Hepialus humuli*, L. ; the damage was particularly severe in one commercial field in which plants in their third year of cropping were more severely affected than younger ones, and the crop was greatly reduced. Other attacks were reported in the same district. Control is difficult, and soil dressings of naphthalene [**32** 16] have not proved very effective. *Incurvaria* (*Lampronia*) *rubiella*, Bjerk., is a major pest of raspberry in Scotland and is found locally in south-eastern England. An outbreak occurred on raspberry at East Malling in 1946 ; in consequence the young shoots were hollowed, nearly all the young growth withered and died, and the crop was destroyed. The established canes were burned in June, leaving only the new growth, as a result of which most of the larvae were killed.

EATON (J. K.). **The Formation of Phosgene from DDT and related Compounds.**— *34th Rep. E. Malling Res. Sta. 1946* pp. 129–130, 5 refs. East Malling, 1947.

The possibility that DDT or compounds related to it may evolve phosgene when mixed or heated with certain materials used in the control of pests or diseases was examined following a press report that small animals had been killed by phosgene produced when a horticultural dust containing DDT was mixed with copper oxychloride. No phosgene was detected when p,p′DDT, o,p′DDT, technical DDT (80 per cent. p,p′isomer), p,p′DDD (1,1-dichlor-2,2-bis(parachlorphenyl)ethane) or p,p′DDX (1,1-dichlor-2,2-bis(parachlorphenyl)-ethylene) were mixed or heated with copper oxychloride, when technical or p,p′DDT was heated with 2 per cent. dinitro-o-cresol in petroleum oil, or when DDX was heated with oxidising agents, but one of the latter (a mixture of potassium dichromate and sulphuric acid) caused its evolution from DDD and the three forms of DDT. It is concluded that the conditions of vigorous oxidation required for the production of phosgene from technical DDT or its major components are unlikely to occur in agricultural practice.

RIEMSCHNEIDER (R.). **Der o,m′-DDT-Wirkstoff.** [The o,m′ Isomer of DDT.]— *Angew. Chem.* **61** no. 8 p. 333, 3 refs. Berlin, 1949.

The author states that in addition to p,p′, m,p′, o,p′ and o,o′DDT, he has prepared o,m′DDT. It resulted as a condensation product of β,β,β-trichlor-α-(metachlorphenyl)-ethanol and chlorbenzene in concentrated sulphuric acid, almost the only other isomer produced being m,p′DDT, which occurred in larger amounts. It was separated from the latter by a process of concentration and chromatographic adsorption on aluminium oxide. Its identity was shown by decomposition to o,m′-dichlorbenzophenone and o,m′-dichlordiphenyl acetic acid.

The insecticidal value of o,m′DDT is not great. When the five isomers were tested against *Musca domestica*, L., and *Melophagus ovinus*, L., the order of decreasing effectiveness against both insects was p,p′, m,p′, o,p′, o,m′ and o,o′DDT.

TURNER (J. N.). **Simple Tests on the Effectiveness of some chlorinated Hydrocarbon Insecticides against the Leather Beetle** (*Dermestes maculatus* **Deg.**).— *Bull. ent. Res.* **41** pt. 2 pp. 289-299, 5 graphs, 13 refs. London, 1950.

A simple and rapid method of evaluating new contact insecticides that is suitable for use in industrial laboratories is described, and an account is given of the work leading to its adoption for tests of p,p′DDT, chlordan and the γ isomer of BHC (benzene hexachloride) against *Dermestes maculatus*, Deg., an important pest in the leather industry [*cf. R.A.E.*, A **38** 294]. It involves the production of a dry film of the insecticide by smearing a small volume of a standard solution across a glass photographic plate by means of a microscope slide, and the subsequent measurement of its toxicity by exposing test insects on it. Solvents that boiled between 60 and 100°C. [140 and 212°F.] produced more even films than those with higher boiling points, and chloroform, which gave a reasonably even film if the glass plate was quite dry, was finally adopted. The microscope slide retained about 5 per cent. of the total volume of the solution used, and the slightly thickened edge of the film contained about 10 per cent. more insecticide than the rest of it ; this source of error was minimised in the case of DDT films, which were dense and heavy, by removing the thickened edges apparent to the naked eye. The volatility of γ BHC and chlordan, of which 12 and 1·8 mmg. per sq. cm., respectively, was lost from the films on exposure to still air for six hours, introduced a further error, though, in the case

of γ BHC, the fumigant action of the vapour had some compensatory effect ; both these materials lost toxicity with increasing age, and no increased toxicity was shown with old DDT films [*cf.* B **34** 122].

The results of the first tests against *D. maculatus*, in which adults were used, were very variable, and this was not overcome by maintaining the temperature during exposure more nearly constant or by prolonging the period for which the insects were kept in clean dishes after exposure to compensate for differences in the rate of action of the insecticides. When the deposit of DDT exceeded about 0·4 mg. per sq. cm., films composed of tightly packed clusters of small crystals were produced, and these were less effective than the larger radiating clusters of needles produced in lighter deposits. The other factor of importance in influencing the results was found to be the size of the test insects, large ones being more resistant to both BHC and DDT than small ones ; the females of *D. maculatus* tend to be larger and heavier than the males, but there were no other important differences due to sex.

The tests showed that the median lethal deposits of chlordan, γ BHC and DDT for the adults were 0·375, 1·6 and 230 mmg. per sq. cm., respectively. Last-instar larvae were much more resistant than adults, and DDT was again inferior to chlordan or γ BHC. DDT had no effect on the eggs, but killed the newly hatched larvae, and the vapour of γ BHC prevented hatching. For commercial use on skins, the recommended rates are not less than 8½ oz. per 12,000 sq. ft for γ BHC, which is approximately equivalent to 3½ oz. per ton of dry-salted goatskins, and about half this for chlordan. The volatility of γ BHC appears not to be a disadvantage, since skins treated with it when baled retained their toxicity after storage for several months, but it might prove so under adverse storage conditions, such as may occur in tropical countries or during shipment over long distances.

Dirsh (V. M.). **Two new African injurious Grasshoppers.**—*Bull. ent. Res.* **41** pt. 2 pp. 317–320, 16 figs. London, 1950.

Eyprepocnemis noxius, sp. n., and *Catantops joycei*, sp. n., are described from the Anglo-Egyptian Sudan, and *E. noxius* is also recorded from Tanganyika and Nigeria. Both are stated to be serious pests of cotton and sorghum in the Sudan, where *C. joycei* also attacks the flowering heads of sunflower [*Helianthus annuus*] and the leaves and young fruit of *Sesamum orientale*.

Rivnay (E.). **The Mediterranean Fruit Fly in Israel.**—*Bull. ent. Res.* **41** pt. 2 pp. 321–341, 13 figs., 9 refs. London, 1950.

Improved irrigation has extended the areas in Israel in which fruit trees are grown and is expected to extend them further. *Ceratitis capitata*, Wied., however, limits the production of summer fruits, though some *Citrus* crops may escape it [*R.A.E.*, A **30** 21] ; it infests apricots and peaches to such an extent that they can be grown only in the hills and in general need protection, and also attacks plums, apples and pears severely in localities in which it is abundant. The position has become still more serious in recent years owing to the introduction of exotic subtropical fruit ; of these, guavas must be harvested before they ripen to prevent infestation of the whole crop, and some varieties of mango and avocado can be grown successfully only if the fruits are picked early or protected by means of bags.

In laboratory studies of the effects of environmental factors on the different stages, the larvae developed most slowly in apple and progressively faster in pear, peach and fig ; the rate in two varieties of apple of different texture differed considerably. The rapid development in fig is probably due to the high sugar content. Development was retarded when the food medium began

to ferment and less sugar was available ; the acidity of the fermenting juice may also have checked growth. The larvae completed their development in 15 days at 22°C. [71·6°F.] or 11 days at 26°C. [78·8°F.] in grapefruit and 17 days at 18·5°C. [65·3°F.] or 7·5 days at 29°C. [84·2°F.] in figs, and the pupal stage occupied 8, 9·3, 25 and 35 days at 29, 25, 17 and 15°C. [84·2, 77, 62·6 and 59°F.] ; the thresholds of development were calculated to be 10–11°C. [50–51·8°F.] for the larvae and 11°C. for the pupae. A daily exposure of the pupae for six hours at 32–37°C. [89·6–98·6°F.] caused no injury, but a similar exposure at 42°C. [107·6°F.] brought about a heavy mortality. Daily exposure to 46°C. [114·8°F.] for one hour caused considerable injury, and exposure for three hours resulted in 80 per cent. mortality. This explains the very high mortality of the pupae in the groves during June–August. The duration of the preoviposition period varied greatly [**28** 270] and was affected by food, the occurrence of mating, the activity of the female [**30** 402] and the rate of development of the eggs in the ovarioles, of which the last two are both influenced by temperature. Development of eggs did not occur at 18–22°C. [64·4–71·6°F.], and was retarded at 23–25°C. [73·4–77°F.] ; the optimum temperature was 27–29°C. [80·6–84·2°F.], and temperatures of 33–34°C. [91·4–93·2°F.] were detrimental. Adults lived longest at 16–19°C. [60·8–66·2°F.], at which temperature 50 per cent. remained alive for 100 days, though all were dead in 200 days.

Observations on the fluctuations of adult populations in the coastal plain were made in 1937–44 by exposing trap-jars containing Clensel in a grove of subtropical fruits (including some *Citrus*) that was surrounded by *Citrus* groves and provided a continuous food-supply. In 1937–38, the trees were young and bore little or no fruit, and the numbers of flies were small then and in 1939. In 1940–41, *Citrus* fruits were left on the trees until May–June, and the flies increased enormously, as many as 4,000 being taken per trap in ten days. In later years, no *Citrus* fruits were available after April, and the fly populations were reduced to normal proportions. The monthly fluctuations in populations are discussed with reference to climatic conditions. The flies are least numerous in December–January, when they may be absent if temperatures are sufficiently low, and July–August, when the high temperatures destroy many pupae and, combined with low humidity, reduce the fertility and shorten the lives of the adults ; this period also follows a time when few fruit are available for oviposition. In the Upper Jordan Valley, the summer depression in numbers was more marked, and populations were much higher in spring than in autumn. In the hills, the flies did not appear until early June. They reached peak numbers in July and August, and decreased rapidly in September, remaining at a low level till the following June.

MILES (M.). **Studies of British Anthomyiid Flies.**—*Bull. ent. Res.* **41** pt. 2 pp. 343–354, 2 figs., 19 refs. London, 1950.

The following is largely based on the author's summary. Further observations were made in Kent on the life-history and habits of the bean seed flies, *Hylemyia* (*Chortophila*) *cilicrura*, Rond., and *H.* (*C.*) *trichodactyla*, Rond., which are again both included under the former name [*cf. R.A.E.*, A **36** 173]. The flies came to moist, freshly turned soil at all times from April to October, particularly in warm, bright weather, but the number seen on observation plots was affected by the area of damp and disturbed soil nearby. Both males and females were attracted, and some females laid eggs within a few minutes of capture. When isolated in phials and fed on dilute sugar solution, captured flies lived for up to 79 days. Captured females spent periods that varied up to 44 days before laying eggs, which were usually deposited in batches of less than ten at irregular intervals over periods extending up to 28 days ; 53 eggs

per fly was the highest number recorded. Some adults were found to be parasitised by the nematode, *Heterotylenchus aberrans*. Eggs of *Hylemyia* were found in soil crevices and on vegetation in contact with soil. The observed incubation period was 2–4 days, according to temperature. The duration of the larval instars was affected by temperature ; in captivity, the larval feeding period was 8–16 days in May–June and 15–24 days in October–November. The pupal stage lasted 16–21 days in May–June and from five weeks to five months in autumn and winter. A few flies emerged during January and February in the insectary. In captivity, first-instar larvae found food buried at a depth of 6 ins. and they were able to reach maturity on fragments of vegetation buried in sand. It is suggested that they are primarily scavengers on organic matter in the soil.

In the course of these investigations, larvae of *Hylemyia* (*Pegohylemyia*) *fugax*, Mg., were taken, sometimes in considerable numbers, in the stems and crowns of turnips and swedes, and in cabbages, cauliflowers, lettuces and brussels sprouts. They were always associated with insect pests or with disease-causing bacteria or fungi. In the laboratory, they were successfully reared on the leaves and stems of cabbage infected with bacterial soft rot, but not on healthy tissues, and it is concluded that they are saprophytic. Pupation takes place in the soil and in the feeding sites. Adults were present from May to October and were taken on cabbages, cauliflowers, brussels sprouts and lettuces and about small heaps of weeds and rakings. Eggs were found on these four crops on the backs of leaves, on dead leaves, in leaf axils, and in cracked or damaged stems. The life-cycle from egg to adult lasted 4–5 weeks in spring, and winter was passed in the pupal stage.

Cowland (J. W.) & Hanna (A. D.). **The Cotton Jassid, *Empoasca lybica* (de Berg.) during the dead Seasons in the Gezira, Anglo-Egyptian Sudan.**— *Bull. ent. Res.* **41** pt. 2 pp. 355–358, 1 ref. London, 1950.

Vegetation is scarce in the Gezira for about the first half of the period between mid-May, when the cotton from which the crop has been harvested is destroyed, and August, when the new crop is sown, and surveys were carried out in the northern Gezira during May–June to determine what becomes of *Empoasca lybica*, Berg., at this time, with a view to developing a method of control between crops. All stages were found on vegetables and weeds in gardens and along the river bank but not by canals. Lists are given of 13 plants on which breeding took place, and 14 (including *Acacia arabica*) on which only adults were found, and of a few additional plants on which breeding occurs at other seasons. Nymphs were collected from the leaves of vegetables and weeds in a garden in the central Gezira on 14th July 1947 ; the numbers obtained per 100 leaves on egg-plant (*Solanum melongena*), *S. dubium*, *Hibiscus esculentus*, *Abutilon glaucum* and jute (*Corchorus olitorius*) were 540, 497, 413, 190 and 0, respectively.

The movement of Jassids to cotton was recorded by means of an adhesive screen that was set up at the beginning of August. No Jassids were trapped during the rains, and only few in mid-November, from which it is concluded that numbers on cotton build up rapidly from small initial populations. These were shown to be largest in cotton fields near gardens, which are the chief sources of infestation.

Attempts in 1947 and 1948 to exterminate the Jassid in gardens by spraying all the plants in them with emulsions containing 0·1 or 0·5 per cent. DDT during the season when cotton is absent were not successful, since the plants became reinfested after about a week. It is thought that reinfestation came from adults that had been present on *Acacia arabica*, since these trees were not sprayed in 1947 and only the lower parts could be reached in 1948.

HANNA (A. D.). **The Effect of Rainfall on the Cotton Jassid, *Empoasca lybica* (de Berg.) in the Gezira, Anglo-Egyptian Sudan.**—*Bull. ent. Res.* **41** pt. 2 pp. 359–369, 7 figs., 3 refs. London, 1950.

Empoasca lybica, Berg., is always abundant and often very injurious on cotton in the northern part of the area covered by the Gezira Irrigation Scheme, always present but only occasionally of economic importance in the central part, and rarely injurious in the south. The causes of these differences in infestation were studied in 1947, when the average numbers of nymphs found per 100 leaves in the three areas on 11th November were 1,125, 650 and 139, respectively. There was no appreciable difference between the water and nitrogen contents or the thickness of the epidermis of cotton leaves from the northern and southern Gezira or between infestation on the two varieties of cotton most extensively used in these areas when grown side by side, and infestation could not be correlated with the prevalence of weeds at the beginning of the rains or the abundance of predators, which included larvae and adults of *Coccinella rufescens*, Muls., *Cydonia vicina*, Muls., and *Exochomus melanocephalus*, Zoubk. (*nigromaculatus*, Goeze), and larvae of *Chrysopa vulgaris*, Schn. There is a marked difference in the rainfall in the two areas, however, and a definite inverse correlation was found between the number of showers in which rainfall exceeded 10 mm. that occurred during July–August and the number of adult Jassids present. The lower surfaces of the leaves were found to become splashed with mud during the rains, and when cotton leaves were sprayed twice with water containing fine dust, the number of Jassids on them was reduced by over 90 per cent., whereas spraying with water alone caused a reduction of only 14·2 per cent. The soil in the southern Gezira contains more clay than that in the north, and when a sample from each area was weighed before and after exposure to rain, more soil was lost from the former than from the latter. Jassids increased much more quickly on egg-plants protected from mud splashes than on others that were not, but numbers on the latter suddenly increased when the plants reached a height of 33 cm. and their upper parts were beyond the range of the mud splashes. It is therefore concluded that mud splashed on to the leaves of the plants by rain is a limiting factor in the distribution of *Empoasca* ; rain in July and August kills a high proportion of the Jassids on the abundant weeds that appear when the rains begin late in June, and rain during the second week of August destroys many that have already migrated to cotton seedlings. By September and October, the cotton leaves are large enough to protect the soil from the rain. Cotton growing near sorghum in the northern Gezira was more heavily infested than that near fallow land, probably because the spreading leaves of the sorghum protect the soil from rain and thus favour the development of large populations on weeds under them.

The evidence indicated that Jassid damage is negligible where the total amount of rain falling in showers of more than 10 mm. each during July–August exceeds 250 mm., slight where this total is between 250 mm. and 230 mm., and considerable where it is less than 230 mm., and it is suggested that this correlation might be used as a basis for forecasting intensity of attack.

HOWE (R. W.). **Studies on Beetles of the Family Ptinidae. I. Notes on the Biology of Species in Britain.**—*Ent. mon. Mag.* **85** pp. 137–139, 3 refs. London, 1949. **II. Fineness of Foodstuffs as a Factor influencing the Rate of Development of *Ptinus tectus* Boield.**—*T.c.* pp. 189–190. **III. A two-year Study of the Distribution and Abundance of *Ptinus tectus* Boield. in a Warehouse.**—*Bull. ent. Res.* **41** pt. 2 pp. 371–394, 6 figs., 5 refs. London, 1950.

In the first of these three parts, the author states that the only Ptinid of major importance as a warehouse pest in Britain is *Ptinus tectus*, Boield. ;

outbreaks of *Niptus hololeucus*, Fald., occasionally occur, and several other species are widely distributed, though rarely numerous or destructive. The recently introduced *Eurostus hilleri*, Rttr. [*R.A.E.*, A **28** 531] is now present in few, if any, warehouses, and *P. villiger*, Rttr., which is a pest in Canada [**38** 55], has been prevented from becoming established in Britain by rigorous inspection and the use of suitable control measures. A method for rearing Ptinids in the laboratory is briefly described ; fishmeal is employed as food for *P. tectus*, *P. fur*, L., *Gibbium psylloides*, Czemp., and *Stethomezium squamosum*, Hinton [**31** 368], and middlings for the other species. *P. tectus* does not survive at temperatures above about 28°C. [82·4°F.] ; it can develop at 10°C. [50°F.] and oviposit at 5°C. [41°F.], and development and oviposition are possible at a relative humidity as low as 30 per cent. The optimum conditions are 22–25°C. [71·6–77°F.] and 80–90 per cent. relative humidity. Under favourable conditions, as many as 600 eggs are deposited per female. Parasites of Ptinids are not common in Britain, but *Dimachus discolor*, Wlk., was found in London warehouses ; cultures of *Trigonogenius globulus*, Sol., and *Niptus hololeucus* were attacked by a bacterial disease, which could not be transmitted to other species. It is unlikely that any will become as injurious as *P. tectus*, since all except *E. hilleri* require considerably longer for their development, and the fertility of *E. hilleri* is very low, fewer than 50 eggs being deposited per female in the laboratory. When several species are reared in company, mortality is lowest in *P. tectus*.

In the second part, he gives an account of experiments in which larvae of *P. tectus* were reared on fishmeal or soy-bean flour that had been separated into five grades by being passed successively through sieves with 10, 20, 30, 40 and 50 meshes per inch, and on dehydrated vegetables that had been passed through sieves of 10–30 and 50 meshes per inch. Development was progressively faster in all cases as the food particles became finer, but was significantly faster only in the case of the finest food. In this case it was significantly faster for total populations or females alone but not for males. In a similar experiment in which the larvae were reared on sieved fractions of wheat flour, there were no consistent differences in the case of Canadian vitamin-fortified white flour, but development was faster in coarse wholemeal flour than in fine ; most of the bran and germ, and, in consequence, most of the B-group vitamins, are retained in the coarse fraction when wholemeal flour is sieved.

In the third, he describes observations made in two rooms of a warehouse in Buckinghamshire. The following is virtually his summary. In 1945, fortified flour was stored in them in a single tier of upright sacks, whilst in 1946, the rooms were empty except for 50 small experimental bags of wheatfeed (fine middlings). Before the flour arrived in 1945, no insects were found except a few Ptinid larvae in a bag of sweepings. Adults of *P. tectus* soon appeared on the sacks of flour, and the numbers on the sacks in one room increased steadily to 6,000 by the time the flour was removed in November. The increase was erratic in the other room, where the ecological conditions were obviously variable, but there were 4,500 adults on the sacks by the time the flour was removed. The numbers on the experimental bags in 1946 rose from 0 to 5,000 by the end of September. The weekly figures varied with temperature, falls in numbers coinciding with colder weather. In both years, a steady 30–40 per cent. of the total numbers of *P. tectus* on the sacks or bags were found at the bottom except for the early months of 1946, when 80 per cent. were at the base of the bags until April. In empty premises, it was obvious that many adults hid in the fabric of the building, a rough estimate of 150,000 being obtained in one of the rooms following the use of traps and marked beetles. There were indications that the main hiding place in this building was at the junction of walls and floor. After the sacks of flour had been removed in 1945, it was estimated that the flour covering the floor of one room contained

about 7,000 larvae. These would normally be removed by sweeping and vacuum cleaning, but this treatment left behind about a further 10,000 larvae in the floor cracks of each room. No estimate of larvae inside the sacks was possible, but in eight months in 1946, about 1,500 eggs were laid in each small bag of wheatfeed. The average number of eggs laid per day in the room in 1946 was at least 300.

P. tectus has two complete generations a year. All stages may survive the winter so that overlap of generations is complete. In a stack of sacks of flour, adults are most abundant on the sacks at the edge of the stack, especially on those near the corners. Draughts, wetness and sunshine caused local changes of distribution. There was some indication that the beetles preferred to rest on cotton sacks rather than on jute. Larvae are normally present only in the outer layers of flour in a sack, and spin cocoons on the inside surface of the sacking. The adults emerge through the sacking to the outside. The activity of *P. tectus* in a warehouse is greatest during darkness. Hence it is fairly continuous in dark premises and periodic in light places. In the latter, beetles emerge from their hiding places at dark and return at dawn. If dark crevices are provided artificially, they act as traps, for some of the beetles will use them as daytime hiding places. Activity is reduced by low temperature, but does not stop altogether until it is as low as 2°C. [35·6°F.].

Two methods are suggested for estimation of the numbers of beetles without too much labour. One for estimating the numbers on sacks is based on the fact that most of the beetles are found on outside sacks, and involves counting those on several representative groups of contiguous sacks. Over half the estimates made by this method in one of the rooms in 1945 were within 20 per cent. of the correct values as indicated by total counts of the population. The combination of traps with the release of marked beetles is suggested for estimating the resident population of empty premises.

BASDEN (J. F.). **A Method of distinguishing the larval Stages of** *Agriotes sputator* **(L.) (Col., Elaterid.).**—*Bull. ent. Res.* **41** pt. 2 pp. 395–413, 9 figs., 33 refs. London, 1950.

The following is the author's summary. The different instars of *Agriotes sputator* larvae cannot be distinguished by measurements of total length or of various parts of the wireworm. The number of teeth on the mesothoracic and abdominal spiracles increases with age, and an examination of 700 wireworms showed that the average numbers of teeth on the two thoracic or on all the abdominal spiracles fell into eight groups. These criteria were valid for populations collected at different times of the year. The number of teeth on the thoracic spiracles of a larva in any particular group approximates to that on the abdominal spiracles of a larva in the next larger group. The eight groups formed by counting either the thoracic or the abdominal spiracle teeth represent growth stages and not necessarily instars. The larvae may sometimes moult without growth, a phenomenon probably caused by an inadequate supply of food. At such an ecdysis the number of spiracle teeth does not increase. The larvae pupate after attaining an optimum size, and reach this size in seven or eight growth stages. A quick method of determining the growth stage to which a larva belongs is given, whereby more than 80 per cent. of the larvae are placed in their correct growth stages by counting the teeth on one spiracle only ; for less than 1 per cent. of the larvae is it necessary to examine as many as five spiracles ; an accuracy of more than 97 per cent. can be maintained. The possibility of determining the relationship of growth stage and age is discussed. The division of the larvae into those which will pupate after seven, and those which will pupate after eight growth stages is apparent at a very early stage in the life history. One larva was found which appeared to be in its ninth growth

stage. The cause of this difference in growth stage number is unknown. It may be due to the size of the egg, to the time of the year at which hatching occurs, or to heredity.

SAWYER (K. F.). **Aerial Curtain Spraying for Locust Control : a theoretical Treatment of some of the Factors involved.**—*Bull. ent. Res.* **41** pt. 2 pp. 439–457, 16 figs., 5 refs. London, 1950.

The following is the author's summary. This paper deals with the aerial curtain method of spraying flying swarms of locusts with insecticide from aircraft [*cf. R.A.E.*, A **37** 314]. Equations are developed for calculating the dosage deposited on locusts in single spraying runs under idealised conditions. Graphical methods of solving the equations are described, together with a simple method for obtaining the summed effect when a number of spraying runs are carried out in a regular sequence to form an aerial curtain. There is an optimum combination of spray droplet size distribution and spraying height according to the depth and density of the swarm, but good performance can be obtained with a single fixed droplet size distribution. A fine spray is recommended for the attack of flat-topped, shallow swarms, but a coarser spray is required to penetrate adequately into deeper and denser swarms. The efficiency of application of the insecticide solution, calculated as the proportion of lethal doses actually applied to those potentially available, may be as high as 10 per cent., but varies rapidly with spray droplet size and swarm characteristics. The numerical values given may need some modification in the light of further experimental and field data, especially in regard to locust airspeed in the swarm and the effect of droplet size on mortality.

HOGAN (T. W.). **The Australian Plague Locust. Aerial Spraying Campaign.**—*J. Dep. Agric. Vict.* **47** pt. 8 pp. 369–375, 7 figs., 1 ref. Melbourne, 1949.

A severe outbreak of *Chortoicetes terminifera*, Wlk., in northern Victoria in the spring of 1946 was controlled by the application from aeroplanes of sprays containing BHC (benzene hexachloride), supplemented by the use of baits, and an account is here given of the procedure adopted in the aerial campaign, together with a discussion of the results, the factors influencing them, and the cost. This is thought to be the first occasion in which such a campaign has been used as the principal means of controlling an outbreak. The terrain treated was mostly flat or broken by undulating sand hills and under wheat, pasture or *Eucalyptus* scrub, though it also contained some valuable irrigated crops. Hatching began in early September, and long-distance traverses made across the area indicated that the proportion of it occupied by hopper bands varied from 0 to 5 per cent. The density of hoppers in bands containing those of up to about the third instar was about 50 per sq. ft. By 16th October, the hoppers had formed large bands that varied in size ; some covered several acres and travelled considerable distances, though not in any one general direction. Winged locusts were abundant in the first half of November, many in swarms in which the density was only 1 or 2 per sq. ft., though in some it exceeded 20.

Spraying against the hoppers was begun on 16th October, and since large bands were very numerous, was confined to infested crops that were likely to be severely damaged ; only bands that exceeded 20 acres in extent were sprayed. In November, when spraying against the adults was begun, attention was concentrated on one district at a time, and it was found that the application of the spray to only a few thousand acres within a district caused locusts to disappear from the whole of it ; swarms were often reported flying out of a treated area, but followed no general direction. Spraying could probably

have been begun earlier with advantage, since it was found that the great density of hoppers in isolated bands more than compensated for the waste of spray on uninfested areas between the bands.

In general, the aircraft flew across the wind, beginning on the downwind side of the area. The runs were marked by means of smoke generators or, in open country, by means of flags ; runs exceeding half a mile in length were undesirable, as communication between the markers then became difficult. With experience, the ground and air crews could spray effectively without the aid of wireless communication or smoke generators. The spray employed was a 4 per cent. solution of BHC (13 per cent. γ isomer) in diesel fuel oil and was applied from modified Beaufort Mark IX aeroplanes [*R.A.E.*, A **35** 416] in swathes 70 yds. wide at a rate of approximately 4 gals. per acre. Mortalities throughout the campaign were lower than those obtained in tests with a spray of 5 per cent. BHC [*loc. cit.*], but were of the order of 90 per cent. when spraying conditions were favourable. They were lower among hoppers than among adults and where weeds or bent or broken stalks of cereal crops formed a dense cover of vegetation, but did not appear to be influenced by temperature. The results were not affected by wind velocities up to 10 miles per hour, but stronger wind dispersed the spray over too wide an area for satisfactory control. The accuracy of the application depended on the wind, as well as on the skill of the operators, and it was found advantageous to lay the first swathe beyond the edge of the swarm. The aircraft were usually flown at an altitude of about 25 ft., which was satisfactory except at very low wind velocity, when the spray became concentrated in a rather narrow swathe ; such overspraying may result in increased residual action, however. The diesel fuel oil did not injure cereal crops or pasture land, but the leaves of vegetable crops and vines were spotted by the heavier drops, and it therefore became customary to spray a barrier area round such crops or, where they were already invaded, to spray them with an emulsified solution of BHC by means of hand pumps. Livestock did not feed readily on newly sprayed pasture, but when given no alternative food, ate it without ill effects. Milk from cows that grazed on treated pasture was not tainted by BHC. Beekeepers were warned of the imminence of spraying, and no reports of mortality of honey bees were received.

During the campaign, pasture land and crops over an area of about 30,000 acres were sprayed, about 28,000 gals. of spray being used against hoppers and 92,000 gals. against adults, and bait was applied over some 7,000 acres. As a result, damage was reduced to a minimum and migration to southern Victoria, where there were valuable wheat crops, was in general prevented. Dense flying swarms that entered Victoria from New South Wales in December were effectively dispersed by the sprays ; some oviposition took place in parts of the north-east, but no hatching was reported. Migration from New South Wales was of little importance, however, since most of the locusts developing there were destroyed by drought.

MAY (A. W. S.). **The Control of *Heliothis* in Linseed.**—*Qd agric. J.* **68** pt. 4 pp. 216–220. Brisbane, 1949.

In 1948, infestation by *Heliothis armigera*, Hb., the bionomics of which are briefly described, became serious on flax grown for linseed in Queensland. The likelihood of the outbreak had been foreseen, however, and severe losses were prevented by precautionary cultural control measures. Flax planted in autumn rarely suffers damage until the seed capsules are forming in spring, and since the flowering plants are very attractive to the ovipositing moths, the amount of damage caused depends on the number of moths present in spring, the time when they are ready to oviposit and the time the flax flowers. In the spring of 1948, when the overwintered population was large owing to favourable

conditions for breeding on various crops and weeds in the preceding summer and autumn and for the survival of the pupae in the soil in the intervening winter, crop damage increased very much with lateness of flowering in September and October. Planting in early May gave the best results, though still earlier planting might have been better. The rate of sowing is also important ; a relatively dense stand of plants was found to ensure an even rate of seed development and to prevent late flowers, which increase the period over which the crop is attractive for oviposition. Applications of a 5 per cent. DDT dust [*cf. R.A.E.*, A **37** 42] or a spray containing 0·2 per cent. actual DDT as a dispersible powder or in an emulsified solution gave satisfactory control. If necessary, treatment should be begun soon after flowering and before the larvae have done much damage to the crop.

FRIEND (A. H.). **A Consideration of the Fruit Fly Problem and some Details of recent Control Tests.**—*Agric. Gaz. N.S.W.* **60** pt. 1 pp. 35–39, 1 fig., 11 refs. Sydney, 1949.

A previous experiment having shown that bait-sprays splashed on the plants offered greater promise than cover sprays of slow-killing insecticides for the control of *Dacus* (*Strumeta*) *ferrugineus tryoni*, Frogg. [*R.A.E.*, A **37** 40], further tests were made in New South Wales in 1948. In a small test on pear in January–February, the numbers of punctures per fruit averaged 1·7 for a standard bait-spray of tartar emetic and sugar applied ten times, 4·2 for a cover spray of 0·2 per cent. DDT applied three times and 4·7 for no treatment. Fruit-fly activity was such that neither treatment resulted in much undamaged fruit. Subsequently, from 27th February to 7th March, daily applications of bait-sprays containing sugar with tartar emetic, HETP (hexaethyl tetraphosphate) or a mixture of nicotine sulphate and DDT, or four applications of a DDT cover spray, all gave complete control on blackberry on 8th March, while 34 larvae were found in 200 ripe fruits from untreated plants. In the laboratory, droplets of HETP with sugar on *Citrus* leaves gave rapid mortality of flies for at least 23 hours, and in early April, two fig trees were splashed with a bait-spray of 1 cc. of a proprietary preparation of HETP and 1 oz. sugar in 1 pint water. The numbers of dead flies found during the three following daylight periods on a tarpaulin spread under one of the trees were 98 (71 in the first hour), 5 and 0, respectively, while smaller but similarly distributed numbers were obtained in two days from the other. Another application was made to the latter on the third day, after which large numbers of dead fruit-flies were found. Temperature and humidity were unchanged during the experiment.

As HETP killed the flies more quickly than any treatment previously tested, its rapidity of action and lasting effect were compared with those of other phosphorus insecticides, nicotine sulphate and tartar emetic in solutions containing 6·3 per cent. sugar. Droplets of the solutions were applied to leaves of potted *Citrus* in a glasshouse, and the leaves were picked after various periods and placed in tubes with 2–3 fruit-flies each. In the first experiment, the numbers of hours after which at least 50 per cent. mortality was observed were : 0·5 for nicotine sulphate, TEPP (tetraethyl pyrophosphate) and HETP at dilutions of 1 : 500 and parathion at 1 : 3,333, and 21 for tartar emetic at 1 : 320, as compared with 120 for sugar only, when the leaves were tested three days after application ; 21 for parathion, TEPP and HETP when they were tested 13 days after, and 21 for parathion and 120 for TEPP and HETP three weeks after. When the mixed solutions were kept for three days and then applied to leaves shortly before testing, all but tartar emetic gave very inferior results. HETP and TEPP were also tested at 1 : 100 three weeks after application, and 50 per cent. mortality was obtained in 21 and 120 hours, respectively.

In a further experiment, the leaves were tested eight days after application, and the numbers of hours after which 50 and 100 per cent. mortality were observed were 2·3 and 4 for nicotine sulphate (1 : 500), 6·5 and 6·5–24 for tartar emetic (1 : 320), 0·5 and 4 for TEPP (1 : 500), 2·25 and 6·5 for HETP (1 : 500) and 0·5 and 2·5 for parathion (1 : 3,333), as compared with 144 and over 240 for sugar only. Similar tests with parathion at 1 : 500 were then made for as long as the fruit-flies were available. The last batch all died within six hours when exposed to leaves treated 52 days previously.

Rodrigo (P. A.). **Soybean Culture in the Philippines.**—*Philipp. J. Agric.* **13** no. 1 pp. 1–22, 5 pls., 14 refs. Manila, 1947.

This paper includes a section on the insects that attack soy bean in semi-commercial plantings in the Philippines, which has been revised by F. Q. Otanes (pp. 18–19). *Mocis undata*, F. (*Remigia archesia*, Stoll) sometimes causes serious injury during the rainy season. The eggs are laid on the lower leaf surfaces, and the larvae devour first the lower surface and then the whole leaf. They can be controlled by dusts of derris or lead arsenate. Adults of *Riptortus atricornis*, Stål, suck the juices of the developing pods and prevent the development of seeds, and have caused severe injury in some districts. They can be controlled by spraying with contact insecticide or trapped at light. Cutworms are serious pests of soybean grown in the rainy season. They eat large quantities of the leaves and can be controlled by dusts or sprays of lead arsenate applied in the afternoon. Scattering poison bran bait and hand collection are also useful. Soy beans for forage should not be treated with arsenicals but should be harvested before they are defoliated. Other insects that have occasionally attacked the plants are *Ferrisia virgata*, Ckll., *Halticus minutus*, Reut., *Bemisia inconspicua*, Quaint., species of *Agromyza* and *Homona* and Aphids.

Putta Rudriah (M.). **Field Control of the Earhead Pests of Jola** (*Andropogon sorghum*).—*Mysore agric. J.* **25** no. 3 pp. 48–53, 10 figs., 1 map. Bangalore, 1947.

In 1944, severe damage was caused to late crops of sorghum in Mysore by *Calocoris angustatus*, Leth., *Contarinia andropoginis*, Felt, and *Stenachroia elongella*, Hmps., all of which feed on the young grains. *Calocoris* [*cf. R.A.E.*, A **30** 366] oviposits between the glumes and the grains and sucks the latter, and *Contarinia* lays its eggs in the flowers and the larvae develop in the grains. The larvae of *Stenachroia* cut the grains and web them together, and the ears become black with excreta entangled in the webbing and broken grains. The larvae of *Eublemma silicula*, Swinh., and *Celama internella*, Wlk., also occur in the ears but are less injurious. The infestation in 1944 reached its peak in July and August, when the grains were still developing, but in 1945, when sorghum was sown at the beginning of April, the insects did not appear until the grains began to harden, and damage was negligible. In June 1946, late crops were attacked by *Calocoris* and *Contarinia* in some districts but infestation by *Stenachroia* was light.

From June to August in 1945 and 1946, a dust of finely powdered soap and waste tobacco (1 : 1) was used in demonstration control tests. A muslin bag of dust was fixed in the top of a cylindrical basket, and each ear was treated separately by enclosing it in the basket and shaking dust on it. Contact with the dust caused paralysis and death of the insects, and treated ears were freed from infestation in 24–48 hours ; applications to uninfested ears prevented attack for about a week.

Syed Usman. **The Green Beetle Pest (*Leptispa pygmoea*) of Paddy and its Control in Malnad in 1946.**—*Mysore agric. J.* **25** no. 3 pp. 54–59, 5 figs. Bangalore, 1947.

An account is given of observations in Mysore on the bionomics and control on rice of *Leptispa pygmaea*, Baly, which is confined to the Malnad districts of Kadur, Shimoga and Hassan. In 1946, as a result of heavy rainfall from June to September, an outbreak of this Hispid occurred on large areas of cultivated rice. The eggs are laid on the foliage and the larvae feed on the upper surfaces of the leaves, which fold over and hide them. Pupation takes place on the leaf and the adults emerge after a few days and feed on the leaves, but to a less extent. The numbers of beetles on single blades ranged from 2 to 13, and the numbers of adults per sq. ft. in severely, moderately and freshly infested fields averaged 31, 11 and 4, respectively.

In experiments on control [*cf.* also *R.A.E.*, A **27** 291], good results were given by applying kerosene to form an even film on the water in the plots and dislodging the beetles from the upper part of the plants with sticks or brooms ; 75–80 per cent. of the beetles were dislodged and 99 per cent. of these destroyed. Since kerosene was found to scorch rice seedlings, the tops of these were clipped off and destroyed with the beetles on them. Tests with a high-acidity transformer oil gave similar results, and it was shown to be effective under rainy conditions. Dusting with a proprietary preparation of benzene hexachloride diluted in wood ash gave only 40–45 per cent. mortality and the beetles did not die for 3–4 hours. The dust can be applied to fields that are not irrigated, however, and its use avoids disturbing the plants. A DDT dust and spray, a dust of sodium fluosilicate, light-traps and preparations of various insecticidal plants proved useless. The outbreak was controlled by mid-October.

Hammond (G. H.). *Phyllophaga* **spp. Control with volatile Soil Fumigants. A Progress Report.**—*77th Rep. ent. Soc. Ont. 1946* pp. 14–19, 2 refs. Toronto, 1947.

Work on the value of chlorpicrin and other volatile fumigants injected into the soil for the control of *Lachnosterna* (*Phyllophaga*) spp. was continued in Ontario in 1945, when second-year, third-instar larvae were present near the surface of the soil, and 1946, when third-instar larvae, pupae and dormant adults were present at much greater depths [*cf. R.A.E.*, A **35** 10]. The other fumigants tested were ethylene dibromide and mixtures of dichlorpropane and dichlorpropene, methyl bromide and xylene, and methyl bromide, ethylene dichloride and carbon tetrachloride. These mixtures are abbreviated as DD, MX and MEC, respectively ; the proportions of the ingredients in them are not stated. The tests were made in semi-permanent meadow and pasture on well-drained, deep, sandy loam with relatively high populations of *Lachnosterna* that caused severe damage in 1945. In each year, 5, 9, 12 or 16 injections were made per sq. yard ; the fumigants were injected to a depth of 5 ins. at rates of 1 cc. per injection in 1945 and 2·75 cc. in 1946. No control plots were employed, as natural mortality in the short period for which the experiments were in progress was negligible. Chlorpicrin, ethylene dibromide, MX and MEC were tested in both years, and DD and mixtures of equal parts of DD and ethylene dibromide and of DD and MEC were also tested in 1946. Mortality counts were made after 4–10 days. In general, all the materials gave good control, and were least effective against the dormant beetles at the lower rates. Chlorpicrin was not tested against adults, but killed all the larvae at all injection rates and all pupae at all rates except the lowest, which killed 97·9 per cent. Its action was rapid, but it was very toxic to the

vegetation and relatively costly. Ethylene dibromide, MEC and MX gave good control at nine or more injections per sq. yard, did not injure the plants, and had no objectionable odour ; MX showed a marked reduction in effectiveness against the dormant beetles at depths exceeding 10 ins. DD was especially effective against the third-year larvae and the pupae ; rates of 12 and 16 injections per sq. yard killed all the dormant adults present, but the lower rates gave irregular results, probably owing to slow lateral diffusion, since vertical diffusion exceeded 12 ins. in many cases. It injured the plants, though less severely than chlorpicrin. The mixture of DD and ethylene dibromide killed all the dormant beetles at all rates, and the mixture of DD and MEC killed all at the two higher rates and 91·5 per cent. at nine injections per sq. yard. In one test in 1945, all the four materials tested gave high mortality in 24 hours and killed almost all the larvae in 100 hours. MX and MEC were the most rapid in action.

From these results, an injection depth of 5 ins. is considered satisfactory for the third-year stages, but too great for the second-year larvae feeding near the surface, probably because a gas that is heavier than air tends to move through the soil vertically rather than horizontally. A rate of 12 evenly spaced injections per sq. yard is considered adequate, provided that temperature and humidity are favourable. Although the third-year stages can be readily controlled by all the materials tested, the best time for treatment is when the first- or second-year larvae are feeding near the surface of the soil.

A suspension of DDT applied to sod infested by second-year larvae gave fair control, and an emulsion concentrate containing 20 per cent. DDT diluted with water (1 : 20) and applied at 2·5 gals. per sq. yard gave 94·9 per cent. control. A DDT powder and solutions of benzene hexachloride [*cf.* also **38** 188] gave irregular short-period results.

VICKERS (L. G.). **Comparison of some D.D.T. Formulations.**—*77th Rep. ent. Soc. Ont. 1946* pp. 19–20. Toronto, 1947.

Tests of the toxicity to *Musca domestica*, L., of DDT deposits on glass, which are noticed in more detail elsewhere [*R.A.E.*, B **38** 210], indicated that deposits from solutions are more toxic than those from emulsified solutions. The crystals deposited by the emulsions tended to form aggregates, with individual crystals scattered between them, and those deposited by the oil solutions to form straight lines of uniform thickness, independent of any foci.

BOYCE (H. R.). **Long Term Trends in Parasitism of Twig-infesting Oriental Fruit Moth Larvae.**—*77th Rep. ent. Soc. Ont. 1946* pp. 21–34, 5 graphs, 1 ref. Toronto, 1947.

The following is largely the author's summary. Information secured during the years 1929–46 on the parasitism of twig-infesting larvae of the oriental fruit moth [*Cydia molesta*, Busck] on peach by the introduced *Macrocentrus ancylivorus*, Rohw., and several of the more important native parasites, is compiled for the two peach-growing areas of Ontario [*cf. R.A.E.*, A **28** 422]. *Cremastus minor*, Cushm., and *Angitia* (*Dioctes*) *obliterata*, Cress., were the most important native parasites attacking first-generation larvae in Niagara, and *Angitia* was the most important in south-western Ontario. *Glypta rufiscutellaris*, Cress., was of no value against this generation in either area. It was the most abundant native parasite of the second generation in Niagara, except in 1938 and 1944, when *C. minor* predominated. In south-western Ontario, *Glypta* was more important as a second-generation parasite than in Niagara, and *C. minor* was moderately abundant only in 1931. Parasitism by *Glypta* showed a marked reduction when *Macrocentrus* was abundant, but increased again when numbers

of *Macrocentrus* fell, probably because it is unable to compete with *Macrocentrus* when both are present in the same host larva, but can maintain a large population in native hosts.

Following its introduction in 1929 and 1930, *Macrocentrus* increased rapidly and maintained high populations as a parasite of both first- and second-generation twig-infesting larvae in Niagara, except in 1942 and 1945. It was able to return to effective levels in this area following severe reductions without supplementary liberations. It has not been so successful in south-western Ontario. Greatly improved control has resulted from its addition to the parasite complex, mainly owing to its effect in reducing the first-generation population in addition to populations of the succeeding generations. None of the native parasites was consistently effective, though *Glypta* was frequently of major importance in south-western Ontario.

Data on total parasitism of the first-generation larvae and injury to twigs by the second generation generally serve as a reliable index of the effects of parasitism on the host population. Decreases in fruit infestation have occurred following high first-generation parasitism and reduced second-generation twig injury.

Wishart (G.). **Important Reduction of three introduced Pests in British Columbia by introduced Parasites.**—*77th Rep. ent. Soc. Ont. 1946* pp. 35–37, 11 refs. Toronto, 1947.

During a visit in 1946, the author made observations on the status of some introduced parasites in British Columbia. *Aphelinus mali*, Hald., which was introduced into Vancouver in 1921 and into the Okanagan Valley in 1929 [*cf. R.A.E.*, A **20** 67 ; **26** 485] against *Eriosoma lanigerum*, Hsm., on apple, was generally distributed throughout the fruit-growing areas. No outbreaks of *Eriosoma* have occurred since it became established, and all colonies of the Aphid in the areas visited were heavily parasitised. *Allotropa utilis*, Mues., was introduced from Nova Scotia in 1938 against *Phenacoccus aceris*, Sign. [**31** 152]. Populations of that mealybug, although slightly greater in unsprayed orchards, were low in all the areas visited, and parasitism by *A. utilis* varied from 10 to 80 per cent. Egg masses were scarce and no honey-dew was seen, though there was evidence of past heavy infestations.

Ascogaster quadridentata, Wesm., *Glypta haesitator*, Grav., and *Angitia* sp., were first liberated against *Cydia* (*Laspeyresia*) *nigricana*, Steph., on peas on Sumas Prairie in 1937, and the combined parasitism by *A. quadridentata* and *G. haesitator* increased steadily until it reached 80·11 per cent. in 1945 [*cf.* **37** 271], *Ascogaster* being responsible for almost all of it. Infestation of peas was heavy in 1945, so that sowing was restricted in 1946. Although infestation of the pods would be expected in such circumstances to be heavy, it fell from 80 per cent. in 1945 to 35 per cent. in 1946 where the parasites were numerous. In an area west of Sumas where no parasites had been liberated, and to which they had not spread naturally, infestation of early peas was 76 per cent.

Coppel (H. C.). **The Collection of Spruce Budworm Parasites in British Columbia with Notes on their Overwintering Habits.**—*77th Rep. ent. Soc. Ont. 1946* pp. 38–40, 1 ref. Toronto, 1947.

Collections of *Choristoneura* (*Archips*) *fumiferana*, Clem., and its parasites in British Columbia, made in connection with the introduction of the latter into eastern Canada [*cf. R.A.E.*, A **36** 78], had to be restricted to a single locality in 1946. As counts on three Douglas firs [*Pseudotsuga taxifolia*] showed that 66 per cent. of the larvae of *Choristoneura* were more than 10 ft. above the ground, the collecting technique adopted included shaking the insects from the

higher branches on to mats. During the season, 22,238 Dipterous puparia 12,678 larvae and cocoons of *Phytodietus fumiferanae*, Rohw., and 364,070 pupae of *C. fumiferana* (from which a further 17,527 Dipterous puparia were reared at Belleville, Ontario) were obtained.

Notes are given on the overwintering habits of some of the parasites. Of the four that have been released in eastern Canada, *P. fumiferanae* overwinters as a mature larva in a cocoon, and *Agria* (*Pseudosarcophaga*) *affinis*, Fall., in its puparium in the ground. *Ceromasia auricaudata*, Tns., parasitises *Choristoneura* in summer, but the adults are numerous in autumn when *Choristoneura* larvae are not present. In 1946, however, several adults of *Ceromasia* emerged from overwintered pupae of *Hyphantria cunea*, Dru. The Tachinid must therefore lay its eggs on the foliage of both conifers and deciduous trees. The overwintering habits of *Phorocera incrassata*, Smith, which are not known, are thought to be similar to those of *Ceromasia*, as it also deposits its eggs on leaves. The other parasites are of less importance and most of them attack a wide range of hosts. First-instar larvae of *Glypta fumiferanae*, Vier., *Apanteles fumiferanae*, Vier., and *Angitia* (*Horogenes*) sp. have been found overwintering in the very young larvae of *Choristoneura*. *Bracon* sp. overwinters as a mature larva in a cocoon, and *Phaeogenes hariolus*, Cress., in the adult stage. One mature larva of *Apechthis* (*Ephialtes*) *ontario*, Cress., was observed overwintering in a pupal case of *Choristoneura*. *Lypha setifacies*, West, and *Winthemia* (*Omotoma*) *fumiferanae*, Toth., overwinter in their puparia in the ground. In the case of *Winthemia*, 25 per cent. of the pupae produce adults in July and the rest remain in diapause until the following spring. *Itoplectis obesus*, Cushm., *A. ontario*, *Ephialtes* (*Scambus*) *hispae*, Harr., and *Amblymerus verditer*, Nort., were reared as both primary and secondary parasites, and all four have been observed overwintering as secondary parasites in the cocoons of *Phytodietus fumiferanae*.

Wilkes (A.) & Anderson (M.). **Notes on Recovery of the introduced Spruce Budworm Parasite, *Phytodietus fumiferanae* Rohw. in eastern Canada.**—*77th Rep. ent. Soc. Ont. 1946* pp. 40–44, 2 refs. Toronto, 1947.

Several thousand larvae and pupae of *Choristoneura* (*Archips*) *fumiferana*, Clem., were collected in 1946 in a stand of mixed softwoods near Belleville, Ontario, and at three points near Maniwaki, Quebec, where parasites introduced from British Columbia for its control [*R.A.E.*, A **36** 78] had been liberated in 1944 and 1945, and lists are given of the parasites reared from them. In all, 18 species were obtained in Ontario, where total parasitism was 18·74 per cent. The most abundant, with, in brackets, the percentage parasitism for which they were responsible, were *Meteorus trachynotus*, Vier. (9·2), *Zenillia caesar*, Aldr. (2·1), *Winthemia* (*Omotoma*) *fumiferanae*, Toth. (1·8), *Itoplectis conquisitor*, Say (1) and a species of *Bracon*, probably *B. politiventris*, Cushm. (1) ; a further 3·16 per cent. parasitism by other Hymenoptera included 0·4 per cent. by *Phytodietus fumiferanae*, Rohw., which was the only introduced species recovered. Since the numbers of *C. fumiferana* collected were rather small, the percentage parasitism recorded for each parasite is considered to be indicative only of its relative abundance.

In Quebec, where total parasitism was 10·84 per cent., 13 parasites were reared, of which the most abundant were *Z. caesar*, *Z.* (*Phryxe*) *pecosensis*, Tns., *Glypta fumiferanae*, Vier., *Apanteles fumiferanae*, Vier., and *W. fumiferanae*, which were responsible for 3·6, 2·7, 1·8, 1 and 1 per cent. parasitism, respectively. No introduced species were recovered. Of 1,140 clusters of eggs of *C. fumiferana* collected in Quebec, almost 12 per cent. were parasitised by *Trichogramma minutum*, Ril.

In the discussion that followed, *Phytodietus fumiferanae* was stated to have been reared only from *C. fumiferana* in the field, though it parasitised the ugly nest cherry Tortricid [*Tortrix cerasivorana*, Fitch] in the laboratory. The collections were made principally from Douglas fir [*Pseudotsuga taxifolia*] though some were made from spruce ; in general, the position with regard to the parasites was the same on both trees.

GRAHAM (A. R.). **Feeding of *Pimpla examinator* Ratz. on Host Pupae exposed for Parasitism.**—*77th Rep. ent. Soc. Ont. 1946* pp. 44–45. Toronto, 1947.

Laboratory observations were made on the numbers of host pupae killed by feeding or used for oviposition by females of *Pimpla turionellae*, L. (*examinator*, auct.), which was introduced into Canada for the control of *Rhyacionia buoliana*, Schiff., on pine [*cf. R.A.E.*, A **28** 363]. Ten mated parasite females were caged singly with individual pupae of the fall webworm [*Hyphantria cunea*, Dru.], each lightly wrapped in cotton batting to simulate a cocoon and prevent it from moving when attacked, and sugar and water were provided as food. The females attacked the pupae for oviposition or feeding on the body juices, but rarely used the same host and never the same puncture for both. Of 619 host pupae supplied, 120 were used only for feeding, 343 were examined and not attacked, 148 gave rise to living parasites, and 8 were found to contain dead parasites.

Seven batches of pupae that were attacked between 10th and 27th September were kept at 42–44°F. from 27th to 29th September and at 32–34°F. from 29th September until 4th April, and then transferred to 74°F. Parasites failed to emerge from the last four lots to be attacked, and the best emergence was from pupae that had been kept at 72°F. for five days before being placed in cold storage.

Attempts to substitute pupae of the corn borer [*Pyrausta nubilalis*, Hb.], parsnip webworm [*Depressaria heracliana*, L.] and walnut caterpillar [*Datana integerrima*, Grote & Rob.] as hosts were unsuccessful.

MACNAY (C. G.). **A Summary of the more important Insect Infestations and Occurrences in Canada in 1946.**—*77th Rep. ent. Soc. Ont. 1946* pp. 46–62. Toronto, 1947.

In addition to many pests of common occurrence in Canada, the insects recorded include the Aphid, *Brachycolus tritici*, Gill. [*cf. R.A.E.*, A **4** 196], which was reported in Saskatchewan for the first time in 1946, though it has probably been present there for several years. "Brittle dwarf" of crested wheat grass [*Agropyrum cristatum*], spring wheat and barley infested by it occurred at Saskatoon, and reports of "brittle-dwarf" were received from widely separated areas, but only minor damage resulted. The pea weevil [*Bruchus pisorum*, L.] was observed for the first time in Manitoba, where it occurred on field peas ; this Bruchid continued to increase on peas grown for seed or for canning in Ontario, and infestation in parts of south-west British Columbia was the heaviest yet recorded there. The elm leaf beetle [*Galerucella luteola*, Müll.] was first reported in Canada at St. Catharines in 1945, and by 1946 the infested area had increased to about half a square mile and many elms were completely defoliated. The oyster-shell scale [*Lepidosaphes ulmi*, L.], which was reported from Alberta for the first time in 1945, when it severely damaged *Cotoneaster* at Lethbridge, did not extend its range in 1946, but in that year, *Cotoneaster* at the same place was severely damaged by the pear slug [*Caliroa limacina*, Retz.]. Damage to a building by *Reticulitermes flavipes*, Koll., was observed for the first time in British Columbia during the year, when the sill and flooring of a dwelling were attacked.

Steinhaus (E. A.). **A Coccidian Parasite of *Ephestia kühniella* Zeller and of *Plodia interpunctella* (Hbn.) (Lepidoptera, Phycitidae).**—*J. Parasit.* **33** no. 1 pp. 29–32, 5 figs., 5 refs. Lancaster, Pa., 1947.

The only Lepidopterous insect from which Coccidia of the genus *Adelina* have hitherto been recorded is *Tineola biselliella*, Humm., which is parasitised by *A. mesnili*. In 1946, however, cultures of *Ephestia kuehniella*, Zell., and *Plodia interpunctella*, Hb., each of which had been kept in the same rearing jar for rather more than nine months in a laboratory in California, were found to be heavily infected by a species that in many respects resembles and may be identical with *A. mesnili* [*cf.* also *R.A.E.*, A **15** 625]. The parasite occurs in the fat-body and haemocoele of the larvae and adults, which both remain almost unchanged in appearance, but become sluggish and probably occasionally die, and it was also observed in pupae. Infection among larvae in the later instars appeared to reach almost 100 per cent., but many of them completed their development, giving rise to infected adults. The development cycle of the parasite is described ; transmission from host to host apparently takes place orally by means of ripe oöcysts.

Fales (J. H.), Nelson (R. H.), Ball (W. H.) & Fulton (R. A.). **Storage of Aerosols.**—*Soap & sanit. Chem.* **24** no. 11 pp. 127–129, 2 refs. New York, N.Y., 1948.

In tests in which an aerosol solution consisting of pyrethrum extract (20 per cent. pyrethrins), sesame oil and Freon-12 (dichlordifluoromethane) (2 : 8 : 90) or pyrethrum extract, DDT, cyclohexanone, lubricating oil and Freon-12 (2 : 3 : 5 : 5 : 85) that had been stored for two years was compared with the same mixtures freshly made against freely flying house-flies (*Musca domestica*, L.) in a Peet-Grady chamber, the knockdown and kill were about equal for stored and freshly made formulations released at the same rates. The first was tested again after storage for three, four and five years and still showed no differences from the freshly prepared mixture. When the DDT solution and another consisting of pyrethrum extract, DDT, alkylated naphthalene and Freon-12 (2 : 3 : 15 : 80) were kept in an oven for 26 days at 60°C. [140°F.] and tested against house-flies at rates regulated by the swinging-shutter method and averaging 0·39 gm. per 1,000 cu. ft., the former gave an average mortality of 48 per cent. in one day, as compared with 34 per cent. for an unheated sample, whereas the latter gave 46 per cent., as compared with 55 per cent. when freshly prepared. When the second of these mixtures and the one without DDT were heated for five hours at 85°C. [185°F.] while the paint was being baked on the containers and tested at average rates of 1·4 and 9·26 gm. per 1,000 cu. ft., respectively, the first gave averages of 41 per cent. knockdown in 15 minutes and 80 per cent. kill in one day, as compared with 47 and 76 per cent. for the unheated combination, and the second 83 per cent. knockdown and 70 per cent. kill, as compared with 90 and 67 per cent.

Steel containers in which a solution of DDT, cyclohexanone and Freon-12 (5 : 10 : 85) and one of pyrethrum extract, DDT, lubricating oil, propylene oxide and Freon-12 (2 : 3 : 5 : 5 : 85) had been stored for 36 and 15 months, respectively, showed corrosion, whereas others that had contained pyrethrum extract, DDT, cyclohexanone, lubricating oil and Freon-12 (2 : 3 : 5 : 5 : 85) or pyrethrum extract, sesame oil and Freon-12 (2 : 8 : 90) for 36 months did not. One that had contained pyrethrum extract, DDT, lubricating oil and Freon-12 (1 : 1 : 9 : 89) for 22 months had an oil ring and a black residue below the solution level. Heating the containers before they were filled was found to accelerate corrosion.

Fulton (R. A.). **Propellents for low-pressure liquefied Gas Aerosols.**—*Industr. Engng Chem.* **40** no. 4 pp. 699–700, 3 refs. Easton, Pa., 1948.

Nelson (R. H.), Fulton (R. A.), Fales (J. H.) & Yeomans (A. H.). **Low Pressure Aerosols—their Efficiency in Relation to Formulation and Particle Size.**—*Soap & sanit. Chem.* **25** no. 1 pp. 120–121, 123, 125, 166, 5 graphs, 5 refs. New York, N.Y., 1949.

It is stated in the first paper that since liquefied dichlordifluoromethane (Freon 12) exerts a vapour pressure of about 85 lb. per sq. in. at room temperature, aerosol solutions in which it is the propellent require special containers, which are expensive. Attempts were accordingly made to develop low-pressure aerosol solutions exerting a total pressure of 25–40 lb. per sq. in. at 70°F., which may be used in light containers. Various combinations of solvents and liquefied gases were studied to determine the pressures of the resulting solutions. The more effective of the mixtures tested as propellents were trichlorfluoromethane (Freon 11) and Freon 12 ; methylene chloride and Freon 12 ; pentane, Freon 11 and Freon 12 ; deodorised kerosene and Freon 12 ; propane and methylene chloride ; methylene chloride, Freon 12 and carbon dioxide ; 1,1-difluoroethane and Freon 11 ; and 1,1,1-chlordifluoroethane and Freon 12. Combinations of Freon 11 and Freon 12 in a number of low-pressure formulae containing various proportions of DDT and pyrethrum extract appeared to be satisfactory. As Freon 11 is a better solvent for DDT than Freon 12, the amount of auxiliary solvent, such as cyclohexanone and unsaturated hydrocarbons, could be reduced, but with this mixture it was necessary to avoid the use of the high-boiling fractions of the unsaturated hydrocarbons, which caused the mixtures to separate and so increased the vapour pressure in proportion to the amount of solvent added. A mixture of equal quantities of methylene chloride and Freon 12 gave a vapour pressure of 41 lb. per sq. in. at 70°F., which was reduced to about 37 lb. after the addition of pyrethrum extract, DDT and solvents. Less solvent was required for the DDT when methylene chloride was used instead of Freon 11. Pentane was incorporated with the mixture of the two Freons to lower the vapour pressure, but there appeared to be no advantage in its use because of its poor solvent properties. Approximately 70 per cent. deodorised kerosene was required to lower the vapour pressure of Freon 12 below 40 lb. per sq. in., and the resulting mixture was oily and produced a very coarse mist. Propane and methylene chloride (15 : 85) made a good propellent, but stratification of the two vapours could cause a danger of fire. The addition of carbon dioxide to methylene chloride containing approximately 5 per cent. Freon 12 increased the pressure of the solution, and the large proportion of methylene chloride eliminated the necessity for auxiliary solvents. However, if the carbon dioxide was lost by faulty mechanism before the contents were used, the performance of the remainder would be unsatisfactory. When 1,1-difluoroethane was added to Freon 11, auxiliary solvents were required ; 1,1,1-chlordifluoroethane and Freon 12 formed a satisfactory propellent with auxiliary solvents to hold the DDT in solution.

It is concluded that there are a number of satisfactory propellents for low-pressure aerosols. In developing new formulae a thorough study of compatibility, pressure and action on the valve mechanism is required, and the use of a release device suited to the particular formula is necessary.

The second paper contains an account of investigations noticed in more detail elsewhere [*R.A.E.*, B **38** 206] in which the effect was tested of varying the proportion of non-volatile ingredients from 10 to 20 or 25 per cent. on the vapour pressure of the solution and the particle size and effectiveness against *Musca domestica*, L., of various low-pressure aerosols. The insecticidal constituents were 2 per cent. DDT and 0·15–0·4 per cent. pyrethrins, alone or with a synergist, and the propellent was a mixture of equal weights of Freon 11 and

Freon 12. It is concluded that formulations containing 10–15 per cent. non-volatile constituents are the best. In most cases, there were no sharp changes in particle size or effectiveness for those containing 20 per cent. or less, but the 20 per cent. content is regarded as marginal. Gauge pressure decreased with increasing non-volatile content. In general, insecticidal efficiency was correlated negatively with non-volatile content and particle size. For maximum effectiveness, the content of kerosene should be kept at a minimum.

MARSDEN (S. J.) & BIRD (H. R.). **Effects of DDT on growing Turkeys.**—*Poult. Sci.* **26** no. 1 pp. 3–6, 1 fig., 2 refs. Menasha, Wis., 1947.

The effect of DDT on young turkeys (18–19 weeks old) was studied by feeding them continuously on mash to which the required amount of technical DDT had been added as a solution in groundnut oil. Six turkeys were exposed to each concentration. In a preliminary test, the mash contained 0·3 per cent. DDT and the amount of DDT ingested per bird was estimated to be 95 mg. per kg. body weight per day. Four of the birds died in 8–11 days, and the two survivors had lost weight after 12 days, when the test was concluded. In a further experiment, the rate of growth was retarded in birds given 0·15 and 0·075 per cent. DDT, and five died after 14–34 days and one after 14 days, respectively. Loss of movement, which was evident in nearly all cases prior to death, was preceded by violent muscular tremors. The bird that survived 0·15 per cent. DDT was fed on it for seven weeks ; it showed slight or moderate tremors during the last four weeks of this period and for a fortnight after it had been returned to a normal diet. The turkeys that survived 0·075 were fed on it for eight weeks, and all showed slight tremors after various periods of feeding. Concentrations of 0·038 and 0·019 per cent. DDT had no effect in eight weeks, during which the average amount of DDT consumed daily by the birds ingesting the higher concentration was 16·7 mg. per kg. body weight. The amounts of DDT accumulated in the fat of birds that ingested 0·019–0·075 per cent. DDT for eight weeks ranged from 1·344 to 4·5 mg. per gm. tissue, and that in the bird that ingested 0·15 per cent. for seven weeks was 6·235 mg. per gm. The quantities of DDT found in the kidneys and muscle were much smaller and variable.

RUBIN (M.), BIRD (H. R.), GREEN (N.) & CARTER (R. H.). **Toxicity of DDT to laying Hens.**—*Poult. Sci.* **26** no. 4 pp. 410–413, 7 refs. Menasha, Wis., 1947.

A preliminary trial having shown that 0·5 per cent. DDT in the diet of laying hens was lethal, lower concentrations, as solutions in groundnut oil, were tested. Groups of nine or ten hens received a mixed diet containing 0·25, 0·125, 0·062 or 0·031 per cent. DDT or groundnut oil alone. The test was continued for 12 weeks, during which the amounts of DDT ingested per bird per day averaged 105·6, 80·1, 59·4, 34·3 and 0 mg., respectively. All the ten birds receiving 0·25 per cent. DDT in their diet and nine of the ten receiving 0·125 per cent. died. No birds died as a result of poisoning in the other three groups, and though there was loss of weight in all of them, it was greatest in the group receiving no DDT. The amounts of DDT in the kidney, muscle and fat of a hen that received 0·25 per cent. DDT and survived for 44 days, during which it consumed 3,625 gm. food, were 1·15, 0·122 and 13·69 mg. per gm., respectively, and those in another from the same group that survived for 33 days but consumed only 142 gm. food were 0·024, 0·015 and 0·104 mg. per gm.

Records of eggs laid were kept throughout the experiment and showed that in general production decreased with increasing concentrations of DDT in the diet and with time for a given concentration. Eggs laid in the first six weeks

were analysed for organic chlorine, and the amounts found corresponded to 0·32, 0·36, 0·24 and 0·18 mg. DDT per gm. for hens receiving 0·25, 0·125, 0·062 and 0·031 per cent. DDT, respectively. The slight decrease for hens receiving 0·25 per cent. DDT was probably due to the early cessation of laying in this group. The birds were artificially inseminated during the last six weeks, and the percentage of eggs that hatched was reduced by 0·062 per cent. DDT in the diet, but not by 0·031 per cent.

BOURNE (B. A.). **Effects of Benzene Hexachloride and Chlordane on the Germination of Sugarcane Cuttings.**—*Sug. J.* **10** no. 8 pp. 3–4, 20, 7 refs. New Orleans, La., 1948.

The insects that cause the most damage to the roots of sugar-cane in Florida include white grubs, comprising the larvae of *Lachnosterna* (*Phyllophaga*) spp. and *Cyclocephala immaculata*, Ol., and the wireworm, *Melanotus communis*, Gylh. [*cf. R.A.E.*, A **27** 656 ; **28** 541]. The wireworms also destroy the stem buds and are considered to be a major factor responsible for poor germination and development of plant and ratoon crops in the Everglades region. Damage has been reduced to a certain extent by planting in August and September, but this period is unfavourable on account of the excessive rainfall. BHC (benzene hexachloride) has been reported to give promising results against white grubs and wireworms [*cf.* **38** 405–407, etc.], but in Queensland, higher rates of application were found to retard the growth of sugar-cane [*cf.* **38** 137, 138]. The effect of BHC and chlordan in the soil on the germination of seed-pieces and the early growth of the cane was therefore investigated in 1947. A BHC powder containing 3 per cent. γ isomer was applied at the rate of 1 lb. γ isomer per acre and a 50 per cent. chlordan wettable powder at 4 lb. chlordan per acre, both mixed with the basic fertiliser applied to the open furrows before the seedpieces were planted. All plots were fairly free from wireworms and white grubs. The percentages of buds that sprouted were recorded 12, 33 and 63 days after planting, and the results, which are summarised in a table, showed a significant increase over the controls in the speed in germination and the percentage of buds that had sprouted on each date on plots treated with chlordan. BHC showed a similar tendency, but the increases were not significant.

JEPPSON (L. R.). **Citrus Red Mite Control.**—*Calif. Citrogr.* **33** no. 4 pp. 138, 168. Los Angeles, Calif., 1948.

Following the good results of preliminary experiments [*R.A.E.*, A **36** 155], bis(parachlorphenoxy)methane was extensively tested in sprays and dusts against the red mite [*Paratetranychus citri*, McG.] on *Citrus* in California in 1946 and 1947. The sprays were prepared from wettable powders and comprised conventional dilute suspensions and also concentrated sprays. The latter and the dusts were applied by means of the Master Fan sprayduster and other modern equipment. No injury was caused to the trees under any weather conditions. The sprays gave good control and were superior to the dusts, which left lighter deposits. The acaricide was to be marketed as a 40 per cent. wettable powder (Neotran), and the recommended rates for this are 7·5–10 lb. per 100 U.S. gals. per acre in the sprayduster, and 1·5–2 lb. per 100 U.S. gals. in dilute sprays. When the sprayduster is used, the particles should be relatively fine, a 3/64 disk and a minimum pressure of 100 lb. being suitable, and the equipment should be operated at a speed of about 3 miles per hour. There was no improvement in control when the spray concentration was reduced, provided that the amount of toxic ingredient applied per acre was the same, and the inclusion of oil as an adhesive improved control only where the application

was followed by heavy rain. Dusts and dilute sprays gave satisfactory control of the six-spotted mite [*Tetranychus sexmaculatus*, Ril.] in limited tests, but the sprayduster at 100 U.S. gals. per acre did not. The compound was not effective in field tests against the bud mite [*Aceria sheldoni*, Ewing], the rust mite [*Phyllocoptruta oleivorus*, Ashm.], or any insect pest of *Citrus* ; it appeared to be relatively non-toxic to beneficial predators and parasites. In tests in which it was mixed and stored with most of the insecticides, fungicides and other materials used on *Citrus*, there was no loss of toxicity. Experiments with warm-blooded animals indicated that it is one of the least toxic materials yet developed ; risks from handling it are negligible, and it can be applied to food crops more safely than most insecticides.

Potts (R. C.) & Hensel (R. L.). **Rhodes Grass in Texas.**—*Circ. Tex. agric. Exp. Sta.* no. 116, 17 pp., 7 figs., 2 refs. College Station, Tex., 1947.

Information is given on the cultivation and uses of Rhodes grass (*Chloris gayana*), which is native to South Africa, was introduced into southern Texas about 1910 and has become an important hay and pasture plant there. It is attacked by relatively few insects, but the Coccid, *Antonina graminis*, Mask., was found on it in 1942. A survey in 1945 showed that infestation by this Coccid was considerable in three counties and scattered in seven others. *A. graminis* was also found attacking 16 other grasses, and in view of this and of its wide distribution, remedial measures appear to be impracticable.

Annand (P. N.). **Today in foreign Plant Quarantine.**—*J. econ. Ent.* **43** no. 2 pp. 139–145. Menasha, Wis., 1950.

The author discusses the status of foreign plant quarantine in the United States at the end of 1949 and the ways in which it is being affected by modern developments. In the interests of increasing freedom of world trade, it must be applied in a manner that will permit the freest possible movement of carriers and goods consistent with every safeguard reasonably necessary to prevent the introduction and spread of foreign pests. Increases in traffic by air and sea, including the use of fast ships with adequate refrigeration space (in which products bearing pests may be carried) have complicated the problem of administration, as has also the reduction of luggage inspection by U.S. Customs officers owing to the increases in duty-free allowances to returning residents. Methods of making foreign plant quarantine more effective and less expensive that are being investigated include inspection and treatment of aeroplanes (possibly including the outer surfaces, on which eggs of insects may be carried) at the port of origin or at any point from which there is a considerable volume of direct air traffic to several places in the United States, and the treatment of commodities in the country of origin. International cooperation in such matters is considered very important, and various aspects of it are discussed. Legislation regarding the entry of plant pathogens other than insects and the proper dispersal of ships' garbage containing pest-bearing plant or animal materials is considered desirable. The difficulty of preventing the entry of plant diseases is pointed out, and methods of dealing with it are discussed.

Glass (E. H.). **Parathion Injury to Apple Foliage and Fruit.**—*J. econ. Ent.* **43** no. 2 pp. 146–151, 4 figs., 1 ref. Menasha, Wis., 1950.

The results are given of field tests in New York in 1948 and 1949 and laboratory and greenhouse tests in 1949 on the injury caused to apple by parathion [*cf. R.A.E.*, A **38** 218]. All spray quantities are per 100 U.S. gals.

In the greenhouse, the leaves of potted two-year-old trees of the variety McIntosh and five others derived from it, sprayed when the buds were 1–2 inches long, were injured by 1 lb. or less 15 per cent. wettable parathion, whereas 16 other varieties were not affected by less than 5 lb. and some not by 20 lb. Unpublished work by K. G. Nolan had shown that the degree of parathion injury to such plants as tomato and bean varied according to the carrier used in the wettable powder ; at equal dosages of actual parathion, powders containing such fillers as kaolinite clay caused much more injury than those containing attapulgite clay and certain non-swelling bentonites. Of approximately 100 wettable powders tested, those made from activated bentonites were the safest on foliage ; one made from attapulgite clay was intermediate in safety. On McIntosh apples, parathion formulations differed in the severity of the injury they caused to the foliage, but the degree of difference was not sufficient to be of much practical significance.

When the impurities found in technical parathion were tested at concentrations up to 50–100 times those that would be found in dilute spray mixtures, none had any apparent effect on the trees ; purified parathion caused as much injury as technical parathion (95 per cent. pure). Injury was most severe where large droplets of spray collected, and was reduced by the addition of wetting agents that improved distribution and decreased spray deposits, though they did not eliminate it when 1 lb. 15 per cent. wettable parathion was used. The injury was also reduced by the addition of 10–20 lb. attapulgite clay, and the addition of 20 lb. activated bentonite or 0·25 lb. activated charcoal eliminated it altogether. Activated charcoal at 1 and 2 lb. eliminated injury caused by 2 and 4 lb. 15 per cent. wettable parathion, respectively.

Microscopic studies of suspensions of wettable powders showed that all contained varying amounts of parathion in globules floating free from the carrier. The addition of large quantities of attapulgite clay reduced the number of free globules, and large quantities of activated charcoal or activated bentonite eliminated them. There was a good correlation between free parathion and foliage injury, and it was concluded that it is the free parathion in water suspensions that injures apple foliage.

In the field, foliage injury occurred in 1948 and 1949 on McIntosh and Cortland trees sprayed with 0·5 lb. or more 15 per cent. wettable parathion. It affected young leaves and was most severe at the pink stage, decreasing successively in the calyx and ten-day sprays and not occurring at the first cover spray. The fruits were injured in both years when rain fell soon after application, and there was some evidence that the injury was due to early wetting of the spray deposit.

Taschenberg (E. F.), Avens (A. W.) & Cox (J. A.). **Supplements in DDT Sprays for Control of Grape Berry Moth.**—*J. econ. Ent.* **43** no. 2 pp. 152–157, 1 fig., 12 refs. Menasha, Wis., 1950.

In view of evidence that good control of *Polychrosis viteana*, Clem., on grape-vines by DDT could not be expected unless the sprays contained oil or some other supplement that acts as a spreader and adhesive, and that oil increases the DDT residue at harvest [*cf. R.A.E.*, A **37** 292 ; **38** 246], the authors carried out experiments in commercial vineyards in New York and Pennsylvania in 1949 to find whether a spray supplement was necessary and, if so, which would be the most effective and what residues would be left on the fruit at harvest. The DDT was used at 12 oz. per 100 U.S. gals. as a wettable powder with Bordeaux mixture, and about 200–225 U.S. gals. spray per acre was applied at a pressure of 450–500 lb. per sq. in. with a power sprayer and a covered inverted U-shaped boom carrying seven nozzles on each side of the row and directing the spray upwards and into the foliage and clusters

of the vines. The emergence and flight of the moth were timed by catches in bait-traps containing brown sugar and water with sassafras oil or eugenol.

In one vineyard in New York, the percentage control was less than 90 for three or four applications of DDT without a supplement and usually considerably above 90 when 2 U.S. pints miscible oil prepared with various emulsifiers was added, three applications with oil being at least as effective as four without. In another, two applications of DDT with miscible oil (oil and emulsifier 9 : 1) were followed by one of DDT alone or with oil or various proprietary spreaders and adhesives. There was no marked difference in the degree of control obtained with the various supplements in the last application (94–98 per cent.), but all were somewhat better than DDT alone (90 per cent. control). The first two applications appeared to have a marked influence on control, giving excellent results when followed by a third of DDT with a spreader and adhesive. In one vineyard in Pennsylvania, three applications of DDT with no supplement gave only 67 per cent. control. The addition of 2 U.S. pints miscible oil increased this percentage to 96 and was more effective than soy-bean flour or commercial spreaders.

Examination of the residues on the grapes at harvest showed that these were low for DDT alone and high for 3–4 applications of DDT with miscible oil. When oil was included in the first two applications and no oil-type supplement in the third, residues were not excessive.

Bobb (M. O.). **Insecticides for Control of Plum Curculio.**—*J. econ. Ent.* **43** no. 2 pp. 157–160, 8 refs. Menasha, Wis., 1950.

In 1949, sprays containing 0·25 lb. γ BHC (benzene hexachloride) or parathion as wettable powders, 0·5 lb. aldrin [1,2,3,4,10,10-hexachlor-1,4,4a,5,8,8a-hexahydro-1,4,5,8-diendomethanonaphthalene] as an emulsifiable concentrate, 1 lb. technical methoxy-DDT (methoxychlor) as a wettable powder or technical chlordan as an emulsifiable concentrate or 2 lb. lead arsenate per 100 U.S. gals. were applied to peach trees in Virginia on 4th, 14th and 25th April and 4th May (petal-fall, shuck-split, shuck-fall and first cover sprays) or on the last three dates only for the control of *Conotrachelus nenuphar*, Hbst. The results indicated that the petal-fall application was of little value except in the case of lead arsenate, since eggs were not deposited until the shuck-split stage. BHC, aldrin and parathion all resulted in at least 94 per cent. reduction in infested dropped fruits as compared with lead arsenate, and the percentage reductions in infested fruits at harvest for the three materials were 56·44, 81·9 and 80·35 after three applications and 48·63, 55·14 and 84·4 after four. An additional application of lead arsenate on 6th July against the second generation reduced harvest infestation by 41·56 per cent. on trees that had received three early sprays of BHC, and a similar application of parathion on trees that had received three early sprays of parathion reduced it by 53 per cent. Chlordan was slightly less effective than these three materials at fruit-drop, but more so than BHC at harvest ; methoxy-DDT, though still superior to lead arsenate, was relatively ineffective.

Laboratory tests with BHC, parathion, chlordan, aldrin and methoxy-DDT at the same concentrations showed that BHC gave the highest kill of larvae in peach fruits and that parathion ranked second. Young larvae were more susceptible than older ones. The same sprays and one of 0·25 lb. dieldrin [1,2,3,4,10,10-hexachlor-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene] as an emulsifiable concentrate per 100 U.S. gals. were atomised on overwintered adults in the laboratory and the weevils were then kept with peach fruits and foliage in cages designed to reduce fumigant effects to a minimum. Parathion and dieldrin gave complete kill in three days and no eggs were laid, whereas BHC, chlordan, aldrin and methoxy-DDT gave

66·7, 86·7, 53·3 and 13·3 per cent. mortality in 14 days, and permitted some oviposition in the fruits. Field observations showed that BHC was repellent to the adults. They did not leave the test plot, however, but remained on the ground for some time after each application and returned to the trees and laid many eggs after the completion of the spray schedule.

REED (J. P.) & FILMER (R. S.). **Activation of Ryania Dusts by Piperonyl Cyclonene and N-Propyl Isome.**—*J. econ. Ent.* **43** no. 2 pp. 161–164, 1 ref. Menasha, Wis., 1950.

Dusts prepared from *Ryania speciosa* have given good control of the European corn borer [*Pyrausta nubilalis*, Hb.] on maize [*cf. R.A.E.*, A **34** 137], and have particular value on early sweet maize because, like other plant insecticides, they greatly reduce the incidence of corn smut [*Ustilago zeae*], which sometimes destroys 50 per cent. or more of the ears of early-maturing hybrids. In this paper, the results are given of investigations in New Jersey in 1948–49 to compare *Ryania* dust activated with piperonyl cyclonene or n-propyl isome with other dusts and *Ryania* spray for the control of the borer. Four applications were made to sweet maize at five-day intervals from the time the eggs began to hatch, usually at the rate of 40 lb. per acre. The effect of the dusts on corn smut could not be ascertained, because its incidence in both seasons was low.

In tests against the first generation in 1948, when the first application was made on 18th June, the control percentages (based on numbers of larvae in ears and stalks) were 91·4 for a dust containing 15 per cent. *Ryania* with 0·5 per cent. piperonyl cyclonene, 97·1 for one of 40 per cent. *Ryania* alone, 77 for one of 0·25 per cent. rotenone with 0·5 per cent. piperonyl cyclonene, 94·2 for a spray of 4 lb. ground *Ryania* per 100 U.S. gals. and 97·8 for dusts of either 1 per cent. parathion or 3 per cent. DDT. In treatments against the second generation, begun on 11th August, they were 95 for 15 per cent. *Ryania* with 0·5 per cent. piperonyl cyclonene, 92·2 for 3 per cent. DDT, 95·6 for 40 per cent. *Ryania* and 89·3 for 1 per cent. parathion.

In 1949, when borer populations were low but the corn earworm [*Heliothis armigera*, Hb.] was present, one and two applications of 5 per cent. DDD (TDE) [dichlordiphenyldichlorethane] were made after the four *Ryania* applications against the two generations of *P. nubilalis*, respectively, and one and two additional applications of DDT or parathion after the four of these materials. Against the first generation, dusts containing 40 per cent. *Ryania*, 7·5 or 15 per cent. *Ryania* with 0·5 per cent. piperonyl cyclonene or 15 per cent. *Ryania* with 0·5 per cent. n-propyl isome gave 94·8, 92·1, 89·9 and 90·7 per cent. control, and dusts containing 3 per cent. DDT and 1 per cent. parathion gave 79·1 and 91·1 per cent. Against the second, the same dusts gave 93·6, 91·2, 90·3, 87·1, 97·8 and 100 per cent. control when applied to small plots with a hand duster. When applied with a power duster and followed by an application of parathion against *H. armigera*, 15 per cent. *Ryania* with 0·5 per cent. piperonyl cyclonene and 50 per cent. *Ryania*, both at 30 lb. per acre, undiluted *Ryania* at 12 lb. per acre and 5 and 10 per cent. DDT at 30 and 15 lb. per acre, respectively, gave 45, 81·5, 65·6, 82·8 and 75 per cent. control.

In a test on field maize dusted by aeroplane after the larvae had begun to enter the stalks, two applications on 9th and 16th August of 15 per cent. *Ryania* with 0·5 per cent. piperonyl cyclonene or 1 per cent. parathion, both at 40 lb. per acre, and of 2 per cent. parathion at 20 lb. per acre reduced the numbers of new entries per 100 plants ten days later from 16–24 to 3, 2 and 13, respectively.

The results indicate that piperonyl cyclonene and n-propyl isome exercise a definite synergistic action with *Ryania speciosa* and that the mixtures tested

compare favourably with the standard dust of 40 per cent. *Ryania*, as well as with the other insecticides used.

MARSHALL (G. E.). **Control of Insects in Sod Culture Peach Orchards.**—*J. econ. Ent.* **43** no. 2 pp. 164–166. Menasha, Wis., 1950.

The author discusses the desirability of growing peaches in sod to prevent soil erosion in southern Indiana and gives the results of observations on the control of insect pests and diseases when such cultivation is practised [*cf. R.A.E.*, A **38** 329]. The plum curculio [*Conotrachelus nenuphar*, Hbst.] can be controlled by sprays of either lead arsenate with plenty of lime or chlordan, and the oriental fruit moth [*Cydia molesta*, Busck] by spraying with DDT at intervals of 5–6 days during the third generation.

In 1949, sprays containing 2·5 pints 40 per cent. chlordan per 100 gals. were applied seven times between 5th April and 25th May, one of 3 lb. DDT per 100 U.S. gals. to the trunks against the peach tree borer [*Aegeria exitiosa*, Say] on 23rd June, and sprays of 10 oz. DDT per 100 U.S. gals. under and outside the trees on 14th July and of 8, 10 and 10 oz. DDT outside them on 20th and 27th July and 1st August, respectively. In that year, Tetranychid mites became a problem for the first time, but a spray of 8·33 lb. wettable sulphur with 12 oz. 25 per cent. parathion per 100 U.S. gals. applied to the inside and outside of the trees on 2nd August against mites and scab, gave excellent control. A final spray of wettable sulphur and DDT was applied on 6th August, when the mite population was low. As a result of this schedule, the only important pests were the tarnished plant bug, *Lygus* [*oblineatus*, Say], and Pentatomids, which cause cat-facing of the fruits. They are more destructive on trees grown in sod than on others, but the type of vegetation surrounding the orchard seems to be more important than sod within it, and damage is greatest in years in which the crop is light and when lucerne or clover is planted instead of maize in adjacent fields. In 1949, all cat-faced peaches were removed before 14th June, during thinning, but the percentage of injury was as great by 6th August as it had been before thinning. Cage tests indicated that injury by *Lygus* continues until the middle of July, whereas that due to Pentatomids may cease by 1st June. In tests in which insects were caged over foliage treated with 2·5 pints 40 per cent. chlordan per 100 gals. as soon as it was dry, practically complete kill of curculio and *Lygus* but only about 50 per cent. mortality of Pentatomids was obtained. As cat-facing was far more prevalent in 1949 than in previous years, it is possible that the heavy sprays of lead arsenate and lime used in the past against *Conotrachelus* may have afforded some control of cat-facing insects.

DEAN (R. W.). **Summer Control of Orchard Mites in eastern New York.**—*J. econ. Ent.* **43** no. 2 pp. 167–171, 3 graphs, 2 refs. Menasha, Wis., 1950.

The problem of controlling orchard mites in the Hudson Valley of New York has been complicated by the increased importance of *Tetranychus bimaculatus*, Harvey, due largely to its wide range of food-plants and its ability to breed on the orchard cover growth as well as on the trees. Various acaricides were tested in 1949 in orchards containing moderate to heavy infestation of *T. bimaculatus*, *Paratetranychus pilosus*, C. & F., or both on susceptible varieties of apple. They were applied to both the inside and the outside of the trees with a high-pressure sprayer and combined with insecticides and fungicides when necessary.

In an orchard infested with a decreasing population of mites, mainly *P. pilosus*, sprays of parachlorphenyl-parachlorbenzenesulphonate, alone or with other

acaricides, parathion, TEPP (tetraethyl pyrophosphate), diparachlorphenylmethylcarbinol, S-carbamylmethyl O,O-dimethyl dithiophosphate, O,O-dimethyl S-(2-oxo-2-ureidoethyl) dithiophosphate and ethyl paranitrophenyl thionobenzenephosphonate in July all gave good control. When TEPP was applied twice, the degree of control decreased as the interval between treatments increased from seven to 14 days. In another orchard, in which *T. bimaculatus* was the dominant species, applications on 7th and 18th July of 1 U.S. pint 25 per cent. diparachlorphenylmethylcarbinol, 1 lb. 50 per cent. parachlorphenyl parachlorbenzenesulphonate or 8 oz. 15 per cent. parathion per 100 U.S. gals. and one on 7th July of 2 lb. of the sulphonate preparation all gave good control on 5th August, but one of 1 lb. of the sulphonate preparation with 4 fl. oz. 20 per cent. TEPP per 100 U.S. gals. did not. Over the whole period from 18th July to 26th September all gave significant control and the carbinol emulsion was outstanding. For a short period (25th August to 26th September), S-carbamylmethyl O,O-dimethyl dithiophosphate and O,O-dimethyl S-(2-oxo-2-ureidoethyl) dithiophosphate were very effective, but aldrin [1,2,3,4,10,10-hexachlor-1,4,4a,5,8,8a-hexahydro-1,4,5,8-diendomethanonaphthalene] and dieldrin [1,2,3,4,10,10-hexachlor-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene] were not.

In a third orchard, in which *P. pilosus* was dominant early in the test period, but was replaced by *T. bimaculatus* as the season progressed, particularly on trees on the drier soil, sprays containing parachlorphenyl parachlorbenzenesulphonate, alone or with TEPP, TEPP alone, parathion, butoxypolypropylene glycol, ethyl paranitrophenyl thionobenzenephosphonate, S-carbamylmethyl O,O-dimethyl dithiophosphate, O,O-dimethyl S-(2-oxo-2-ureidoethyl) dithiophosphate, 2,4-dichlorphenyl benzenesulphonate, β-chlorethyl-β-(tert. butylphenoxy)-α-methylethylsulphite, and diparachlorphenylmethylcarbinol, applied 1–4 times on 13th or 23rd June or 2nd, 9th or 16th August, all gave good control by 5th July, and several gave good control until the end of the test period (28th September). Four applications of 1 lb. of the 50 per cent. aryl alkyl sulphite or 50 per cent. parachlorphenyl parachlorbenzenesulphonate or 1 U.S. pint of the 25 per cent. carbinol per 100 U.S. gals. and two of 2 lb. of the sulphonate preparation per 100 U.S. gals. all gave a high degree of control, although none kept the trees free of mites for the entire test period. Of the organic phosphates, 25 per cent. O,O-dimethyl S-(2-oxo-2-ureidoethyl) dithiophosphate, applied twice at 2 lb. per 100 U.S. gals. gave the best control ; 20 per cent. TEPP at 8 fl. oz. in the first two sprays, and 4 fl. oz. in the third and fourth was also satisfactory, although migration of *T. bimaculatus* into trees treated with it was probably reduced by an abundance of green cover growth. Only the butoxypolypropylene glycol damaged the trees in these tests, causing such pronounced scorching of the leaves at the second application that further treatments with it were not attempted.

Lathrop (F. H.) & Hilborn (M. T.). **European Red Mite Control.**—*J. econ. Ent.* **48** no. 2 pp. 172–175, 1 graph, 4 refs. Menasha, Wis., 1950.

The change from small numbers of lime-sulphur sprays to large numbers of wettable-sulphur sprays or sulphur dusts for the control of scab [*Venturia inaequalis*] on apple in Maine in the last 15 years has been accompanied by increasingly frequent and severe infestations of the European red mite [*Paratetranychus pilosus*, C. & F.] and the oyster-shell scale [*Lepidosaphes ulmi*, L.], apparently owing to the destruction of their natural enemies. Because of the correlation between the use of sulphur against scab and the increase of the mite [*cf. R.A.E.*, A **33** 4], alternative methods of control have been sought. The critical period for scab control generally lasts from the time growth starts in spring until petal-fall, and complete control during this period will enable

infection to be kept at a low level during the rest of the season by the use of a comparatively mild fungicide. For the control of the mite, it seems desirable to prevent an increase in population rather than rely on later repressive measures, and this can be done by regular applications of a comparatively mild acaricide after petal-fall.

Attempts to find a fungicide that would not destroy the natural enemies of the mite or would itself possess sufficient acaricidal properties to prevent an increase in population revealed two promising materials. A commercial mixture of glyoxalidines (Crag Fruit Fungicide, 341-C) and 5 per cent. dinitrocaprylphenylcrotonate (Arathane, CR-1639), applied as a spray and a dust, respectively, in all applications after petal-fall controlled both scab and mite. Experiments with the second material are here reported.

In 1948, an apple orchard at Monmouth, Maine, was dusted seven times with bentonite sulphur from the time growth started until mid-bloom, with 15 per cent. lead arsenate added to the early-pink application. Beginning at petal-fall, the trees received eight dust applications of 5 per cent. dinitrocaprylphenylcrotonate, 10 per cent. ferric dimethyldithiocarbamate (Fermate) or bentonite sulphur, 5 per cent. DDT being added to the first three cover applications and lead arsenate to the fifth, sixth and seventh. Treatment was made under favourable conditions ; when the foliage was not wet with dew, water was used to improve adherence. Counts of mites and eggs at frequent intervals from 14th June until 8th September showed that there was little or no change in the population in June, although the numbers of eggs began to increase on trees dusted with the carbamate or sulphur. During July, there was a rapid increase in population on both the latter, and the infestation became so great that dusts of 1·5 per cent. dicyclohexylamine salt of dinitro-o-cyclohexylphenol were applied on 11th and 31st August. There was a gradual increase in July and August on trees dusted with the crotonate, evidently owing to the drift of mites from adjoining severely infested trees, but the population at no time reached a high level. Injury to the leaves, which became increasingly severe after mid-July on the trees dusted with the carbamate and sulphur, did not become important until late August. There was a distinctly greater loss of chlorophyll from the foliage dusted with the carbamate or sulphur and a direct correlation between the weight and size of the harvested apples and the amount of chlorophyll in the leaves. Scab was satisfactorily controlled on both leaves and fruit by all the dusts, and no injury directly due to them was observed.

In 1949, a block of 180 trees received four applications of sulphur dust before flowering and eight of 5 per cent. dinitrocaprylphenylcrotonate dust after petal-fall, as a result of which, scab was satisfactorily controlled and the mite prevented from causing noticeable injury. No special treatment was applied for mite control. Mites became abundant on trees dusted with sulphur throughout the summer, and an application of the salt of dinitro-o-cyclohexylphenol was necessary to protect them from severe injury.

MITCHENER (A. V.). **A Comparison of recent Insecticides with Calcium Arsenate for Control of Potato Insects.**—*J. econ. Ent.* **43** no. 2 pp. 176–178, 1 ref. Menasha, Wis., 1950.

Further investigations on the control of potato pests in Manitoba [*cf. R.A.E.*, A **38** 125] were made in 1949, when *Leptinotarsa decemlineata*, Say, *Empoasca fabae*, Harr., and *Epitrix cucumeris*, Harr., were present in injurious numbers during the growing season, but Aphids were absent. Sprays containing organic insecticides as wettable powders or calcium arsenate were applied at about 72·5 U.S. gals. per acre on 30th June and at twice that rate on 27th July. Amounts of ingredients are per 50 U.S. gals. On 30th June, when adults,

eggs and young larvae of *L. decemlineata* were present but there were few examples of *Empoasca* or *Epitrix*, sprays containing 2 oz. aldrin [1,2,3,4, 10,10 - hexachlor-1,4,4a,5,8,8a - hexahydro-1,4,5,8 - diendomethanonaphthalene] or dieldrin [1,2,3,4,10,10 - hexachlor-6,7 - epoxy - 1,4,4a,5,6,7,8,8a - octahydro-1,4,5,8-diendomethanonaphthalene] gave complete control of *Leptinotarsa* larvae, DDT and toxaphene at 8 oz. were practically as good, and chlordan at 8 oz. and calcium arsenate at 24 oz. were rather less effective. Dead adults were observed on the ground between the rows, and no living adults could be found by 7th July. Adults of *Empoasca* and *Epitrix* appeared on the leaves by 6th July, and nymphs of *Empoasca* were observed on 15th July. Newly emerged adults of *Leptinotarsa* were abundant on untreated plots on 18th July. The results of treatment on 27th July indicated that sprays of 1–2 oz. dieldrin or 4–8 oz. DDT were the most effective in keeping potato plants free of adults of *Leptinotarsa* for at least a few days after application. Numerous adults were present on the untreated plot, indicating that when food is available, their movement at this time may be limited. The DDT spray was the only one, with the possible exception of toxaphene at 8 oz., that destroyed *Empoasca*; it is possible that the first application of DDT had partly prevented infestation. No significant differences were found in the numbers of *Epitrix* on the different plots. After *Empoasca* appeared, the foliage on the plots sprayed with DDT became the healthiest and greenest. Yields of marketable potatoes per acre were highest (383·5 bushels) after the use of 8 oz. DDT and lowest (212·5 bushels) after calcium arsenate. Untreated plots yielded only 96·8 bushels marketable potatoes per acre, largely because almost all the leaves were destroyed by *Leptinotarsa*. Potatoes from plots that had been sprayed with the organic insecticides had no foreign flavour after boiling.

Smith (C. F.), Jones (I. D.) & Calvin (L. D.). **Effect of Insecticides on the Flavor of Peaches—1949.**—*J. econ. Ent.* **43** no. 2 pp. 179–181, 1 ref. Menasha, Wis., 1950.

In further investigations on the effect of insecticides on the flavour of peaches [*cf. R.A.E.*, A **38** 278], made in North Carolina in 1949, the sprays were applied on 2nd and 19th April, 3rd May, 18th June and 5th July, sufficient being used to drench the foliage and fruit so that the drip wetted the soil beneath, and the fruit was harvested on 22nd or 26th July and tasted fresh on 26th and 28th–29th July, respectively. Some of that picked on 26th July was tested after having been canned. All spray quantities are per 100 U.S. gals.

Of the fresh fruit, that sprayed with 4 lb. benzene-hexachloride powder containing 6 per cent. γ isomer and 6 lb. wettable sulphur on the first two dates, followed by 1 lb. 25 per cent. parathion and 6 lb. wettable sulphur on the last three, had a significantly poorer flavour than untreated fruit, that sprayed with 1·85 lb. lead arsenate, 5·4 lb. wettable sulphur and 1·5 lb. basic zinc sulphate or with 6 lb. sulphur alone had a slightly poorer flavour, and that sprayed with 1 or 2 lb. 25 per cent. parathion with 6 lb. wettable sulphur, 1 lb. 25 per cent. parathion with 1 lb. Phygon [dichlornaphthoquinone] or 2·5 lb. 40 per cent. chlordan with 6 lb. wettable sulphur was unaffected. All treatments affected the flavour of the canned fruit, and all but chlordan and sulphur and sulphur alone did so significantly.

Although significant differences in flavour were observed, they were very small, and it is unlikely that they would affect the sale of the peaches.

Adams (A. L.) & Gaines (J. C.). **Sunflower Insect Control.**—*J. econ. Ent.* **43** no. 2 pp. 181–184, 4 refs. Menasha, Wis., 1950.

In view of the possibility that sunflower [*Helianthus*] may be grown economically in Texas, observations were made on the insects attacking it

there and their control. The leaves were eaten by larvae of *Vanessa* sp., and *Estigmene acraea*, Dru., early in the season, by those of *Leucania* (*Cirphis*) *unipuncta*, Haw., in late July and early August and by adults of *Lachnosterna* (*Phyllophaga*) *lanceolata*, Say, and several grasshoppers, of which *Melanoplus differentialis*, Thos., was the most prevalent ; the grasshoppers were the most important, sometimes completely defoliating the plants. The roots were attacked by larvae of *Lachnosterna* (*Phyllophaga*) sp. which caused negligible injury ; the stems by *Rhodobaenus tredecimpunctatus*, Ill., larvae of which bored in them, while the adult weevils made superficial incisions, by *Leptoglossus phyllopus*, L., *Acanthocephala femorata*, F., and *Hymenarcys nervosa*, Say, and by a Longicorn that girdled the stems and caused the death of the heads ; and the heads themselves by *Desmoris fulvus*, Lec. (on wild plants only), *Diabrotica undecimpunctata howardi*, Barber, and *Epicauta* sp., which were all of little importance, and by *Homoeosoma electellum*, Hulst which was the most destructive insect found on cultivated sunflower [*cf. R.A.E.*, A **36** 84]. The adults of *H. electellum* first appeared when the plants began to flower and remained in the field for at least two weeks. Egg masses were laid on the heads in the florets. A severe infestation of larvae, which fed on the head, sometimes destroying the seeds, occurred within a month after the moths appeared. The damage occurred primarily round the margins of the large heads, but extended to the centre of small ones, which were often completely destroyed. At one place, the larvae fed at the back of the large heads and destroyed comparatively few seeds.

On sunflowers planted in early April, applications of 20 per cent. toxaphene with 40 per cent. sulphur or of 3 per cent. γ BHC (benzene hexachloride) with 5 per cent. DDT and 40 per cent. sulphur at 15 lb. per acre on 11th June, after the plants had flowered, reduced populations of *Hymenarcys* and *Leptoglossus* that were migrating into the fields from lucerne, but three further applications of the same dusts at intervals of seven days did not reduce the damage caused by *Homoeosoma*. Both treatments increased the yield somewhat, with no significant differences between them. On sunflowers planted several weeks later in another locality, three applications of these two dusts or of 10 per cent. DDT with 40 per cent. sulphur, made at weekly intervals from 8th July, when about 10 per cent. of the plants were in flower, reduced the percentage of heads infested by *Homoeosoma* from 90·5 to 34·5, 25 and 25·5, respectively, and increased the yield from 156 to 234, 261 and 273 lb. per acre. All treatments reduced infestation significantly, and BHC was significantly better than toxaphene ; the yield increases were also significant, with no significant differences between them. In a third test, two applications of the BHC dust at 15 lb. per acre on 14th July, when about 90 per cent. of the plants had flowered, and a week later increased the yield from 83·6 to 236·8 lb. seed per acre. It is concluded that the timing of treatment against *Homoeosoma* is important and that one application should be made when the flowers first appear, followed by one or two additional ones at weekly intervals.

MEDLER (J. T.) & CHAMBERLIN (T. R.). **Low-volume Sprays for Grasshopper Control in Alfalfa-seed Fields.**—*J. econ. Ent.* **43** no. 2 pp. 185–188, 1 ref. Menasha, Wis., 1950.

Grasshoppers cause considerable injury every year in many lucerne fields used for second-growth seed production in Wisconsin by feeding on the foliage, buds, blossoms and pedicels of seed pods in July, August and September. *Melanoplus femur-rubrum*, Deg., is the most abundant species, and the infestation usually comes from eggs laid in the fields, though many nymphs and adults enter from uncultivated ground. Poison baits have given erratic control, but

low-volume sprays of chlordan and toxaphene have shown promise [*R.A.E.*, A **38** 196]. In 1949, sprays applied at 20 U.S. gals. per acre and a bait of 6 lb. sodium fluosilicate, 100 lb. bran and 1 U.S. gal. molasses at 40 lb. per acre were compared early in the season in fields of timothy grass [*Phleum pratense*]. All reduced the numbers of grasshoppers, most of which were *M. mexicanus mexicanus*, Sauss., but emulsions containing chlordan, toxaphene and aldrin [1,2,3,4,10,10-hexachlor-1,4,4a,5,8,8a-hexahydro-1,4,5,8-diendomethanonaphthalene] at 1, 1·5 and 0·25 lb. insecticide per acre were much more effective in immediate control and lasting effect than the bait or wettable powder spray of lindane [at least 99 per cent. γ benzene hexachloride] at 0·25 lb. per acre. In a test on second-crop lucerne in which the sprays were emulsified xylene solutions applied at 10 U.S. gals. per acre and a pressure of 40 lb., dosages of 0·5, 0·75 and 1 lb. technical chlordan and 1 and 1·5 lb. technical toxaphene per acre all gave highly significant control of grasshopper nymphs after 1 and 6 days.

The application of DDT to second-crop lucerne grown for seed is recommended in Wisconsin for the control of Mirids and Jassids. As DDT gives poor control of grasshoppers, mixtures of it with the insecticides used against grasshoppers were tested at reduced dosages. When applied in mixtures with 0·35–0·5 lb. DDT in 20 U.S. gals. emulsion spray per acre, 0·35–0·5 lb. chlordan, 0·6–0·75 lb. toxaphene and 0·1–0·125 lb. aldrin resulted in six-day averages of 29, 4·5 and 3·5 living grasshoppers per 50 sweeps of a 15-inch net, whereas 0·7–1 lb. DDT, 0·9 lb. chlordan, 0·6–1·2 lb. toxaphene and 0·2–0·25 lb. aldrin resulted in averages of 272, 0, 9·5 and 1·5, respectively. The corresponding averages were 26 for a wettable-powder spray of methoxy-DDT (methoxychlor) at 1·5 lb. per acre and 2–6 for combinations of methoxy-DDT at reduced dosages with toxaphene, aldrin or chlordan.

MOORE (D. H.). **Piperonyl Cyclonene, Pyrethrins, and Rotenone in Dusts to control the Mexican Bean Beetle.**—*J. econ. Ent.* **43** no. 2 pp. 188–190, 3 refs. Menasha, Wis., 1950.

The following is based on the authors' summary. In laboratory tests in Maryland in which larvae or adults of *Epilachna varivestis*, Muls., were confined on dusted bean leaves, a dust containing 0·5 per cent. piperonyl cyclonene, 0·05 per cent. pyrethrins and 0·25 per cent. rotenone (CPR dust) was markedly more effective against the larvae than one of 0·75 per cent. rotenone and comparable in effectiveness with at least 1 per cent. rotenone. It was at least equal in effectiveness to 0·75 per cent. rotenone against overwintering adults collected in the field, but was slightly less effective than the latter against laboratory-reared adults, which were much less resistant to both dusts than the larvae or overwintering adults.

DITMAN (L. P.). **Control of Corn Earworm and other Pests of Corn.**—*J. econ. Ent.* **43** no. 2 pp. 191–193, 2 refs. Menasha, Wis., 1950.

Because of heavy losses of sweet maize caused by the corn earworm [*Heliothis armigera*, Hb.] and the fall armyworm [*Laphygma frugiperda*, S. & A.] and threatened severe infestation by the European corn borer [*Pyrausta nubilalis*, Hb.] in Maryland, experiments were made in 1949 on a commercial method of control using a fixed-nozzle sprayer designed for control of *Heliothis*. The boom was the essential part of the equipment. It was fitted with two pairs of nozzles per row, one pair set 5 ins. above the other on 36-inch drop pipes from the main overhead line. The drop lines were 28 ins. apart, so that the paired nozzles were about 14 ins. from the middle of the row. They were adjusted inward and downward, so that the spray was concentrated on the

ears, and sprays were applied at 25–35 U.S. gals. per acre. Control of *Heliothis* and *Laphygma* was estimated from numbers of injuries per 100 ears, and control of *Pyrausta* from numbers of larvae per 100 plants and 100 ears.

On maize on which the first silks appeared on 26th July, one application of 2 lb. 50 per cent. DDT wettable powder per 100 U.S. gals. at the rate of 200 U.S. gals. per acre on that date against *P. nubilalis* was followed by three on 1st, 4th and 8th August against *Heliothis* of 5 pints 30 per cent. DDT emulsion concentrate and 2·5 gals. horticultural or Deobase oil in 22 gals. water, or 2·5 U.S. gals. 5 per cent. DDT in horticultural oil with 250 cc. emulsifier per 22·5 U.S. gals. water, which gave approximately 70–80 per cent. control of *Heliothis* and 95–100 per cent. of *Pyrausta*, and increased the percentage of uninjured ears from 9·2 to 84·8, 69·5 and 72·4, respectively. On late maize that silked on 29th August and was heavily infested by *Laphygma* at the time of treatment, a spray of 2·5 gals. oil, 5 pints 30 per cent. DDT concentrate and 22 gals. water, applied on 5th September only, 31st August and 5th September or 31st August and 5th and 9th September, increased the percentage of ears uninjured by *Heliothis* or *Laphygma* from 0 to 1·6, 15·9 and 34·8, respectively, and gave 29·5, 40·9 and 40·9 per cent. control of *Pyrausta* and 93, 98·9 and 99·4 per cent. of *Laphygma*. In another field, in which silks appeared on 8th September, all plots, including the controls, received three applications of a 5 per cent. DDT aerosol when the plants were 6–20 inches high against a heavy infestation of *Laphygma*. A spray containing a mixture of 1·8 pints 30 per cent. DDT concentrate with oil to make 1 gal., diluted with water (1 : 9), applied on 6th or 14th September or both or on 9th and 14th September, increased the percentages of uninjured ears from 1·9 to 7·3, 50, 72·2 and 75·5, respectively, and gave 97, 93·9, 99·4 and 97 per cent. control of *Laphygma* and 73·8, 89·3, 85·7 and 85·5 per cent. of *Pyrausta*. Applications on 14th, 6th and 14th, and 9th and 14th September gave 34·9, 64·4 and 63·4 per cent. control of *Heliothis*. Another planting of maize was treated after silking with a dilute DDT spray (1 quart 30 per cent. concentrate per 100 gals.) applied 1–4 times at 200 U.S. gals. per acre with equipment designed for controlling *Pyrausta*. This treatment had little value against *Heliothis* but some against *Pyrausta*, particularly in reducing the ear infestation ; the population in the ears was reduced by 90·8 per cent. with four applications.

It is concluded that the relative ineffectiveness of the dilute spray against *Heliothis* was due to insufficient penetration of the silk channel by the insecticide. Emulsions containing high proportions of DDT and oil were very effective against *Heliothis*, when applied under favourable conditions, even when there was a heavy autumn population. Their effectiveness was determined largely by the thoroughness with which the silks and ears were covered, but straightness of plants and uniformity of ear height and silking period also contributed. These sprays were also very effective in protecting the ears against *Laphygma*, which in years of abundance is the most destructive pest of sweet maize and the limiting factor in the production of late-market sweet maize near Washington, D.C. In several treatments, ear infestation by *Pyrausta* was eliminated and 2–3 earworm sprays reduced the total infestation of the plant by 85·5 and 99·4 per cent. Although infestation by *Pyrausta* was mild, the great reduction of larvae in the stalks by treatment so late in the season was not expected.

Owens (H. B.) & Ditman (L. P.). **Liquefied Gas Aerosols for Home Gardens.**—*J. econ. Ent.* **43** no. 2 pp. 194–198, 1 fig. Menasha, Wis., 1950.

Experiments were carried out in Maryland to assist in the development of a satisfactory aerosol and dispensing equipment for use on small crops of vegetables. For this purpose, an aerosol should be effective against all the

common pests of vegetables without harming the plants unduly and the dispenser should function consistently when used intermittently. Mixtures satisfactory for machine application cannot always be used safely in hand dispensers because of the likelihood of over-application.

The dispensers used were made from low-pressure oxygen cylinders, and the solutions were applied through 5-foot flexible extensions equipped with Wabash refrigeration filters and oil burner nozzles with an output of 1·35 U.S. gals. per hour. They were carried in canvas cases fitted with shoulder straps and charged with 10 lb. solution at a time. Aerosols from solutions comprising DDT, Velsicol AR–60, acetone and methyl chloride (5 : 10 : 35 : 50), pyrethrum extract (20 per cent. pyrethrins), oil, methylene chloride and methyl chloride (2·5 : 10 : 37·5 : 50 or 5 : 10 : 40 : 45) or cubé resin (33 per cent. rotenone), methyl chloride and either acetone or methylene chloride (1·5 : 50 : 48·5) were applied to snap beans, cucumbers, cantaloupe melons and broccoli considerably more heavily than would be practical in commercial use. Treatment of snap beans on five dates between 20th July and 8th August caused no acute injury to the foliage, no dwarfing of the plants and no significant effect on set or size of crop or total yield. None of the insecticides had a significant effect on adults of the Mexican bean beetle [*Epilachna varivestis*, Muls.] or on the numbers of eggs laid. The rotenone mixtures caused a significant reduction of larvae, the pyrethrin mixtures some reduction, and DDT none. Eight applications were made to cucumber between 7th July and 22nd August and eleven to cantaloupes at intervals of 3–7 days. The DDT aerosol caused severe injury to the plants and the others caused some scorching of cucumbers when too heavily applied, but did not effect plant growth. Scorching was most severe when the plants were wet with dew at the time of treatment. The highest yields were obtained with the rotenone and pyrethrum mixtures. Satisfactory insect control was not secured owing to constant heavy migration, particularly of Aphids from untreated plants, though the DDT aerosol was more effective than the others against both Aphids and beetles. Six applications of all the mixtures to broccoli between 22nd August and 28th October were very effective against the cabbage looper [*Trichoplusia ni*, Hb.] and the imported cabbage worm [*Pieris rapae*, L.], but doubtfully so against the cabbage aphid [*Brevicoryne brassicae*, L.]. The Velsicol formula caused considerable scorching of the plants, which apparently resulted in some retardation, as vigorous growth took place after the last treatment, and the more concentrated pyrethrum formula caused some scorching when heavily applied. Such injury caused a delay in maturity rather than a reduction in yield.

It is concluded that none of the mixtures was satisfactory as a general treatment for all four crops. That containing DDT seemed most effective against all insects except *E. varivestis*, but injured all crops except beans. Acute injury was in most instances apparently caused by the Velsicol. The dispensers used were dependable in operation and appeared to be about the right size to be easily handled.

LANGFORD (G. S.), CORY (E. N.) & FOSTER (J. R.). **High Clearance Ground Machinery developed in Maryland for spraying Corn.**—*J. econ. Ent.* **43** no. 2 pp. 198–202, 3 figs. Menasha, Wis., 1950.

In view of the increasing need for efficient methods of spraying maize for the control of the Japanese beetle [*Popillia japonica*, Newm.] and the European corn borer [*Pyrausta nubilalis*, Hb.] in Maryland, the authors discuss the results obtained in two years of experiments with high-clearance tractors and narrow-gauge tractors equipped with various types of sprayers that would apply concentrated sprays quickly over relatively large areas, and the advantages and disadvantages of different types of high-clearance assemblies, spray booms

for concentrated insecticides, mist blowers and multiple-disk microsol sprayers and of narrow-gauge tractor assemblies. Approximately 5,500 acres of maize were sprayed with equipment mounted on high-clearance tractors, and the results showed that several of the machines were very promising. Spraying with 1 lb. DDT in 2–10 U.S. gals. liquid per acre gave outstanding control of *Popillia* but was less effective against *Pyrausta*, for which boom-type nozzles applying DDT or parathion in 15–25 U.S. gals. water per acre showed promise. With equipment mounted on high-clearance tractors, it was possible to spray 50–100 acres of maize in a day at a cost that seemed to make the treatment economically practicable. A hydraulic assembly, with boom and nozzles, mounted on a tractor with a high clearance and long wheel base, operating at a pressure of 300–400 lb. per sq. in. and delivering 15–25 U.S. gals. per minute gave the most complete spray coverage. The mist blowers and multiple-disk microsol sprayers covered the area most rapidly.

Good control of both insects was obtained with sprays dispersed by certain experimental narrow-gauge tractors, but the assemblies tested are not efficient in their present stage of development.

REDDY (D. B.). **Ecological Studies of the Rice Weevil.**—*J. econ. Ent.* **43** no. 2 pp. 203–206, 1 graph, 7 refs. Menasha, Wis., 1950.

The following is based on the author's summary of this account of investigations on the effect of temperature, relative humidity and the moisture content of wheat on the bionomics of *Calandra* (*Sitophilus*) *oryzae*, L., with special reference to oviposition, rate of development and degree of infestation. The number of eggs laid and the percentage that hatched were greatest at 30°C. [86°F.] and 99 per cent. relative humidity. At 13 or 35°C. [55·4 or 95°F.] very few eggs were laid and none hatched. The number of eggs laid increased with relative humidity ; a relative humidity of 73 per cent. or less was unfavourable, and no eggs were laid at one of 30 per cent. No eggs were laid in wheat when its moisture content was only 7·4 per cent., and some were laid but none hatched when it was 9 per cent. Development, although greatly retarded, was completed at temperatures of 25, 26·6 and 30°C. [77, 79·88 and 86°F.], but not at 32°C. [89·6°F.] in wheat with a moisture content of 10·2 per cent., and also at 32°C. when the moisture content was higher. The shortest period of development occurred at a moisture content of 17·6 per cent. (the highest tested). The degree of infestation was greatly influenced by temperature and the moisture content of the wheat. It was highest at 30°C. and a moisture content of 17·6 per cent. On the basis of these results it is concluded that the conditions most favourable for activity of the weevil are temperatures of 28–30°C. [82·4–86°F.], relative humidities of 75–90 per cent. and wheat with a moisture content of 13·5–17·6 per cent.

MOORE (J. B.). **Relative Toxicity to Insects of Natural Pyrethrins and Synthetic Allyl Analog of Cinerin I.**—*J. econ. Ent.* **43** no. 2 pp. 207–213, 7 refs. Menasha, Wis., 1950.

It has been found that complete synthesis of analogues of some of the active principles of pyrethrum flowers is commercially practicable and that the cost of the synthetic allyl analogue of cinerin I, which is the most toxic of them [*cf. R.A.E.*, B **38** 103] and to which the name allethrin is applied, is rather less than that of natural pyrethrins. Seven samples of allethrin were therefore made up into different types of insecticide and compared with similar preparations of natural pyrethrins. The results of assays of the samples by the Soil and mercury-reduction methods are shown.

In water-emulsion sprays prepared with pine oil and containing 1·4 per cent. pyrethrins or allethrin, the pyrethrins were about 2–3 times as toxic as allethrin to the squash bug [*Anasa tristis*, Deg.] and imported cabbage worm [*Pieris rapae*, L.] in the field and to the European corn borer [*Pyrausta nubilalis*, Hb.] in the laboratory ; *Anasa* showed more resistance than the Lepidopterous larvae. When impregnated dusts containing 0·23 per cent. pyrethrins or 0·46 per cent. allethrin were applied in the field against *A. tristis*, *Papilio polyxenes*, F., on dill, *Pieris rapae* and the cabbage looper [*Trichoplusia ni*, Hb.] and in cages against the six-spotted leafhopper [*Macrosteles divisus*, Uhl.] and the cucumber beetle [*Diabrotica*], *Anasa* and *Papilio* were the most and *Trichoplusia* the least resistant to allethrin, and the natural dust was always more effective than the synthetic one. When carefully measured doses were applied to the milkweed bug [*Oncopeltus fasciatus*, Dall.], the median lethal dosages were 4–5 mg. per kg. for pyrethrins and 30–40 and 25–35 mg. for two samples of allethrin. The variation between allethrin samples was within the error of the testing methods.

Other tests, the results of which are noticed in detail elsewhere [B **38** 208], indicated that allethrin is less toxic than pyrethrins to cockroaches, but not to flies [*Musca domestica*, L.]. Its toxicity to cockroaches was, however, greatly increased by the addition as a synergist of piperonyl butoxide or the N-2-ethylhexyl, 2-ethylbutyl or 1-methylisobutyl imide of endomethylenetetrahydrophthalic acid. It is therefore concluded that though allethrin alone is only about 33–50 per cent. as toxic as pyrethrins to a number of field-crop insects, it might be used in combination with synergists to replace pyrethrins for the control of some of them.

ASQUITH (D.). **Dormant and delayed dormant Sprays to control European Red Mite on Apple.**—*J. econ. Ent.* **43** no. 2 pp. 220–221, 5 refs. Menasha, Wis., 1950.

Since H. M. Steiner reported that the application of 1 per cent. oil with the sodium salt of dinitro-o-cresol as a dormant spray, followed by 1 per cent. oil and weak Bordeaux mixture at the delayed dormant stage, was more effective against overwintering eggs of *Paratetranychus pilosus*, C. & F., than 4 per cent. oil with the salt as a dormant spray only and less injurious to apple buds, many growers in Pennsylvania have applied schedules of 1 gal. oil emulsion containing 83 per cent. regular oil (gravity below 31, unsulphonated residue below 90) with 1 quart 19 per cent. sodium salt of dinitrocresol per 100 gals. in the dormant stage and 3 gals. of the same oil emulsion with weak Bordeaux mixture in the delayed dormant stage as standard practice. This has given effective control of *P. pilosus* and the rosy apple aphid [*Anuraphis roseus*, Baker], but has injured the fruit buds when frost has occurred during the delayed-dormant period. Experiments were therefore carried out in 1949 to find a safer split schedule of dormant and delayed-dormant sprays of equal or greater effectiveness.

The treatments were applied to seven-year-old apple trees at a pressure of 450 lb. per sq. in. In the following, spray quantities are given per 100 U.S. gals., and the following abbreviations are used : SDC, TDP and ADP for preparations containing, respectively, 19 per cent. sodium salt of dinitro-o-cresol, 36 per cent. triethanolamine salt of dinitro-o-sec-butylphenol and 18 per cent. ammonium salt of dinitrobutylphenol ; RO for the stock emulsion containing 83 per cent. regular oil, and SO for emulsions containing 97·5 or 99 per cent. superior oil [*cf. R.A.E.*, A **38** 109]. The results were estimated on 28th–29th April by counting the mites on 120 leaves, and a difference of 67 in these figures was significant. They were 40 for a dormant spray of 1 U.S. gal. RO and 1 U.S. quart SDC on 24th February and a delayed dormant spray of 3 U.S. gals.

RO, 2 lb. copper sulphate and 2 lb. spray lime on 7th April, and 24 for 1 U.S. gal. SO and 1 U.S. quart SDC on the first date and 1 U.S. gal. SO with 2 lb. copper sulphate and 2 lb. spray lime on the second ; 672 for 2 U.S. quarts TDP on 24th February, 600 for 1 U.S. gal. ADP on 25th February, and 144 and 176 for 1 U.S. gal. SO with 1 U.S. quart TDP or 2 U.S. quarts ADP on 5th March, when all were followed by 12 lb. flotation sulphur on 8th April ; and 2,368, 376 and 912 for delayed dormant applications only of 12 lb. flotation sulphur alone on 8th April, with 2 lb. 50 per cent. parachlorphenylparachlorbenzenesulphonate on 9th April and with 1·5 U.S. pints 25 per cent. dinitrocaprylphenylcrotonate on 7th April. Trees receiving the delayed dormant applications only had 190, 58 and 79 Aphids per 100 leaves, whereas all others had two or less. Two treatments scorched the tips of exposed leaves, but not seriously. All trees receiving ovicides set fruit as heavily as trees sprayed with sulphur only, though those receiving TDP at the higher concentration in the dormant spray appeared to have more weak lateral growing points than the latter.

The results showed that a total of 1·95 per cent. superior oil was at least equal to 3·32 per cent. regular oil as spray against overwintering eggs of *P. pilosus* in the split schedule, that superior oil combined with the sodium salt of dinitrocresol and with weak Bordeaux mixture was as effective as regular oil in the same combinations and that superior oil with Bordeaux mixture did not scorch exposed leaves at the delayed-dormant stage. The addition of 0·99 per cent. superior oil to the dinitro compounds at half strength significantly reduced the number of surviving mites, but only the first two treatments, of oil and sodium salt of dinitrocresol at the dormant stage and oil and weak Bordeaux mixture at the delayed dormant stage, are considered sufficiently effective for commercial application.

Dominick (C. B.). **Control of Hornworms on Tobacco.**—*J. econ. Ent.* **43** no. 2 pp. 221–222, 1 ref. Menasha, Wis., 1950.

In field tests on the control of *Protoparce sexta*, Joh., and *P. quinquemaculata*, Haw., on flue-cured tobacco in Virginia in 1949, four insecticidal dusts were applied at approximately 18 lb. per acre on 24th August, when the air was calm, and dead larvae were collected 24, 48 and 72 hours later and living ones on the third day. Living and dead larvae showing evidence of parasitism by *Apanteles congregatus*, Say, were not included in the results. *P. sexta* was much more numerous than *P. quinquemaculata*, and most of the larvae were in a late stage of development. Dusts containing, respectively, 10 per cent. toxaphene, 10 per cent. DDD (dichlordiphenyldichlorethane), 1 per cent. dieldrin [1,2,3,4,10,10-hexachlor-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene] and 90 per cent. cryolite gave 66, 50, 30 and 12 per cent. mortality of larvae after 24 hours and 98·5, 96·8, 87·9 and 91·1 per cent. of *P. sexta* and 94·7, 100, 85·7 and 94·7 per cent. of *P. quinquemaculata* after 72 hours. Larvae that were alive at the end of the third day were mostly in the fifth instar.

Connell (W. A.). **DDT and Methoxychlor for Control of Strawberry Weevil.**—*J. econ. Ent.* **43** no. 2 pp. 222–223, 5 refs. Menasha, Wis., 1950.

Tests were made in Delaware in 1949 with commercial dusts containing 3 per cent. DDT with 50 per cent. sulphur and 15 per cent. lead arsenate with 85 per cent. sulphur and a home-made dust containing 5 per cent. methoxy-DDT (methoxychlor) and 50 per cent. sulphur for the control of *Anthonomus signatus*, Say, on strawberry. This weevil sometimes destroys 95 per cent. of the buds on untreated strawberry plantings in years of serious outbreak, but was not generally numerous at the time of the tests. The dusts were applied

with rotary hand dusters on 20th and 28th April at about 30 lb. per acre, and counts of 1,000 buds per plot on 3rd May showed that the percentages injured were 3·4 and 3·6 for DDT and methoxy-DDT and 10·9 for lead arsenate ; the difference between the first two was not significant but that between them and lead arsenate was highly so.

Analysis of the fruit for residues of lead arsenate and methoxy-DDT at harvest on 17th May showed that the quantities of both averaged less than 1 part per million. The DDT residue was not effectively analysed, as the sulphur present interfered with the method used.

Fulton (R. A.), Nelson (R. H.) & Smith (F. F.). **The Toxicity of Lindane Vapor to Insects.**—*J. econ. Ent.* **43** no. 2 pp. 223–224, 3 refs. Menasha, Wis., 1950.

In the course of investigations in which it was shown that the vapour from deposits of lindane [at least 99 per cent. γ benzene hexachloride] left by wettable-powder sprays or aerosols is toxic to *Musca domestica*, L. [*R.A.E.*, B **38** 209], some experiments on Aphids and thrips were also made. A greenhouse with a content of 1,150 cu. ft. was treated with an aerosol released from a mixture of lindane, Velsicol AR-60, acetone and methyl chloride (1 : 10 : 3 : 86) at the rate of 0·1 gm. lindane per 1,000 cu. ft., and ventilated daily. *Aphis gossypii*, Glov., *Macrosiphum* (*Macrosiphoniella*) *sanborni*, Gill., and *Hercinothrips femoralis*, Reut., were then exposed on plant material overnight (17 hours), and the percentage kills were 0, 0 and 95 for exposure after five days and 0, 0 and 77 for exposure after seven days. Analysis of the air immediately after the two exposures showed that it contained 0·3 and 0·2 mmg. chlorine as lindane per litre. In greenhouse sections of 7,000 cu. ft. capacity, that were treated with aerosols at the rate of 0·1 gm. lindane per 1,000 cu. ft. and subsequently ventilated daily, the mortality percentages of the same three insects were 0, 0 and 100 for exposure after a day, 0, 2 and 13 after a week and 0 after a fortnight. When the aerosol was applied at 0·5 gm. lindane they were 78, 93 and 100 after a day, 3, 0 and 55 after a week and 0, 0 and 84 after a fortnight. The air contained 0·3, 0·2 and 0·06 mmg. chlorine as lindane per litre in the first test and 0·6, 0·3 and 0·1 mmg. in the second. In three tests in which the insects were exposed for 17 hours in glass chambers of 24 cu. ft. capacity to air that had passed at the rate of 2 litres per minute through columns of lindane crystals (4 ins. high in the first test and 12 ins. high in the other two), *A. gossypii* suffered 9, 15 and 0 per cent. mortality, *M. sanborni* 21, 73 and 0 per cent. and *H. femoralis* 100, 74 and 12 per cent. Analysis of the air in the chambers after exposure showed that it contained 0·3, 1 and 2 mmg. chlorine as lindane per litre, respectively, but the third test differed from the others in that the air stream was introduced at the bottom instead of near the top of the chamber.

It is concluded that the vapour from lindane has a fumigating action, and that the house-fly and thrips are susceptible to minute traces of the compound and Aphids to concentrations above 1 mmg. per litre.

Dean (H. A.) & Gaines (J. C.). **Comparison of Dusts and Sprays for Cotton Insect Control.**—*J. econ. Ent.* **43** no. 2 pp. 225–226. Menasha, Wis., 1950.

Dusts for the control of insects attacking cotton must be applied when the air is calm, to avoid excessive drift, and this has been a limiting factor in control in some localities. As organic insecticides in sprays applied at a low pressure and low volume per acre during the day had given considerable promise in controlling the weevil, *Anthonomus grandis*, Boh., and the bollworm, *Heliothis armigera*, Hb., they were compared with dusts on cotton near College Station, Texas, during 1949.

Dusts were applied in the early morning while the plants were wet with dew with a rotary hand gun or a tractor duster, and sprays during the day, irrespective of wind movement, with hand or tractor sprayers, both with three nozzles per row each applying 2·5 U.S. gals. per acre. Eggs of *Heliothis* were first observed during the first week in July, and the peak of oviposition occurred about 11th July. Control measures were necessary in some plots before infestation by *Anthonomus*, which migrated to the plants in late July, was considered injurious. As a result of fairly regular rain, the plants produced large numbers of squares, which attracted the weevil for oviposition late in the season. Three experiments were carried out, and the yields of the untreated plots in them were 1,202·5, 1,092 and 689 lb. seed cotton per acre, respectively.

In the first test, eight applications were made between 6th July and 11th August. A dust containing 20 per cent. toxaphene and 40 per cent. sulphur, applied at 3·2 lb. active ingredient per acre, and sprays of toxaphene alone, γ BHC (benzene hexachloride) with DDT (3 : 5), and toxaphene with DDT (2 : 1) at 2·2, 1·1 and 2·2 lb. active ingredient per acre reduced the percentage of squares punctured by *Anthonomus* from 57·6 to 28·3, 43·2, 47·1 and 39·6 and the percentage of bolls injured by *Heliothis* from 17·9 to 3·1, 6·1, 5·9 and 3·8, and increased the yield by 865, 650, 567·5 and 902·5 lb. per acre. All treatments gave significant insect control and yield increase, and all sprays were significantly less effective than the dust against the heavy weevil infestation. The spray of BHC and DDT caused some leaf shedding late in the season and gave significantly less control of *Heliothis* than the dust and a significantly lower yield than the dust or the spray of toxaphene and DDT. The latter spray gave a significantly higher yield than that with toxaphene alone.

In the second test, seven applications were made between 12th July and 19th August. Dusts containing lime-free calcium arsenate with 1 per cent. γ BHC, 20 per cent. toxaphene with 40 per cent. sulphur, 3 per cent. γ BHC with 5 per cent. DDT and 40 per cent. sulphur, and 10 per cent. chlordan with 5 per cent. DDT and 40 per cent. sulphur were applied at 14, 3, 1·3 and 2·4 lb. active ingredient per acre, and toxaphene spray at 2·2 lb. active ingredient per acre. They reduced the percentage of squares punctured by *Anthonomus* from 36·8 to 8·7, 12·1, 12·4, 13·4 and 14·9 and the percentage of bolls injured by *Heliothis* from 23·9 to 5·5, 4·6, 2·8, 2·2 and 5·5 and increased the yield by 1,000, 972, 1,104, 1,126 and 890 lb. per acre, respectively. All gave significant control of both insects and significant increases in yield. The spray was significantly inferior to calcium arsenate against *Anthonomus* and to the other dusts against *Heliothis*. Chlordan with DDT gave significantly better control of *Heliothis* than toxaphene dust and significantly higher yields than the toxaphene spray.

In the third test, eight applications were made between 10th July and 20th August. Two generations of *Heliothis* occurred during July and August, the oviposition peaks occurring on 13th July and during the first week in August. A dust containing 20 per cent. toxaphene and 40 per cent. sulphur and sprays containing toxaphene alone or with DDT (2 : 1) applied at 3·3, 2·9 and 2·8 lb. active ingredient per acre reduced the percentage of squares punctured by the weevil from 20·7 to 11·3, 11·3 and 8·7 and that of bolls injured by the bollworm from 29·3 to 9·4, 9·9 and 3·8, and more than doubled the yield.

MARSHALL (G. E.). **Nicotine Bentonite-DDT Combinations in the Apple Spray Program.**—*J. econ. Ent.* **43** no. 2 p. 227. Menasha, Wis., 1950.

In 1949, apple orchards in the Rio Grande Valley of New Mexico, where very poor control of the codling moth [*Cydia pomonella*, L.] is normally obtained, and in Lawrence County, Indiana, were thoroughly sprayed with a schedule of

two cover sprays of lead arsenate before the first peak of moth flight ; a third of 5 lb. Wyoming bentonite, 1 U.S. pint nicotine sulphate, 1 U.S. quart soy-bean oil and 1 lb. actual DDT [per 100 U.S. gals.] was applied to the inside and outside of the trees when eggs were hatching and the moth flight was approaching a peak. This spray was applied on 6th–8th July in Indiana, and there were no successful larval entries noted for 35 days, after which another application was made, using Mississippi bentonite instead of the Wyoming bentonite. In the Rio Grande Valley there were no entries for 24 days, after which the same spray was applied again. It is possible that the first would have prevented attack for somewhat longer. In Indiana, 92 per cent. of the fruits were free from attack on 20th August, as compared with heavy infestations in neighbouring orchards. Tetranychid mites did not develop to injurious numbers except on trees of one variety that had received no dormant spray, on which a spray of parathion controlled them for the rest of the season. In the Rio Grande Valley, only 5 per cent. of the treated fruits were infested and very few were superficially injured, whereas neighbouring sprayed orchards had 75 per cent. of the crop infested or injured.

Studies in 1947 and 1948 in Indiana and those of 1949 in Indiana and New Mexico indicated that the spray of bentonite, nicotine sulphate and DDT controls mites to some extent and that there is no other safe spray that is more effective in controlling *C. pomonella* over a long period. The standard schedule recommended for Indiana comprised sprays of lead arsenate on 9th May, lead arsenate and DDT on 19th and 29th May and 12th and 26th June and DDT on 4th and 18th July. The tank-mixed schedule suggested consisted of four sprays, lead arsenate on 9th May, nicotine sulphate, bentonite and DDT on 6th–8th June and 11th–12th July and nicotine sulphate and oil on 18th August. The materials cost more, but this was offset by the saving of time effected by the reduction in number of sprays. It did not permit so rapid an increase of mites.

Frost (S. W.). **Potatoes injured by** *Cryptophagus laticlavus*.—*J. econ. Ent.* **43** no. 2 p. 230. Menasha, Wis., 1950.

Larvae of *Cryptophagus laticlavus*, Csy., have been found causing considerable damage to potatoes in common storage in Cumberland County, Pennsylvania. They were very numerous and made shallow borings in the tubers, damaging several hundred bushels. This species is generally found in damp leaves or litter on the ground, and it is considered that it was probably breeding on débris in the store and adapted itself to the tubers, which had been slightly injured by other insects.

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